JTLS

EXECUTIVE OVERVIEW

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Defense Information Systems Agency

JOINT THEATER LEVEL SIMULATION
(JTLS 2.2)

ABSTRACT

The Joint Theater Level Simulation (JTLS) system is an interactive, multi-sided wargaming system that models a joint and coalition force air, land, and naval warfare environment. *The JTLS Executive Overview* provides a general description of its programmatic history, standard hardware, software, and functional capabilities.

The JTLS system consists of six major programs and numerous smaller support programs that work together to prepare the scenario, run the game, and analyze the results. Designed as a tool for use in the development and analysis of operation plans, the model is theater-independent and does not require a knowledge of programming. The JTLS system operates on a single computer or on multiple computers, either at a single or at multiple distributed sites.

Model features include Lanchester attrition algorithms, detailed logistic modeling, and explicit air, ground, and naval force movement. In addition to the model itself, the JTLS system includes software designed to aid in scenario database preparation and verification; entering game orders; and obtaining scenario situational information from graphical map displays, messages, and status boards.

This publication is updated and revised for each version release of the JTLS model. Any corrections, additions, or constructive suggestions for improvement of content should be keyed to specific pages and paragraphs with appropriate justification and forwarded in MCR format to:

JTLS Configuration Management Agent
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3701 N. Fairfax Drive
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1.0 INTRODUCTION

The Joint Theater Level Simulation (JTLS) is an interactive, computer-assisted simulation that models multi-sided air, ground, and naval combat, with logistical, Special Operation Force (SOF), and intelligence support. A component of the Modern Aids to Planning Program (MAPP), JTLS was designed as a tool for use in the development and analysis of joint and combined (coalition) operation plans, but is frequently used as a training support model. JTLS is theater-independent and does not require a knowledge of programming.

1.1 PURPOSE

The purpose of *The JTLS Executive Overview* is to provide a general description of the standard hardware, standard software, and functional capabilities of the JTLS system. A complete suite of documentation (as outlined in Table 1.1 at the end of this section) is provided with the release of each version of JTLS.

1.2 GENERAL OVERVIEW

1.2.1 Date Implemented

JTLS started development in 1983 as a project funded by the U.S. Readiness Command, U.S. Army Concepts Analysis Agency, and the U.S. Army War College. It has had continuous functional and system upgrades since that time.

1.2.2 Description

1.2.2.1 Scope of Conflict

Focus is on conventional joint and combined operations at the Operational Level of War as defined by the Joint Staff's Universal Joint Task List. JTLS explicitly models air, land, sea, amphibious, and SOF operations. The model supports limited nuclear and chemical effects, low intensity conflict, and pre-conflict operations.

1.2.2.2 Terrain

Defense Mapping Agency's ADRG digitized maps and WVBS terrain data permit the model to be used worldwide. The Terrain Preparation System (TPS) can be used to build hexagon-based terrain files to support the JTLS model. The model algorithms assume a hexagon grid is overlaid on a Lambert conformal map projection. A Lambert conformal map projection may lead to undesirable distortion if the map area exceeds a rectangular area larger than 2000 NM on each side.

1.2.2.3 Environment

Hex-based terrain aggregates regional terrain and environmental characteristics: trafficability, elevation, and chemical or nuclear contamination. Roads currently map hex center to center. Pipelines and railroads are mapped via independent node-to-node networks. Rivers and shorelines map to hex borders.

Point targets modify trafficability by providing targetable enhancements to the baseline terrain conditions. For example, bridges, tunnels, and interdiction points can be explicitly represented and targeted. Destruction of the targets affects the underlying terrain representation. Likewise, pumping stations and rail yards can be explicitly represented and targeted. Their destruction affects the underlying capabilities of the associated pipeline and rail networks.

1.2.2.4 Force Composition

Multi-sided coalition air, land, sea, and SOF forces can be represented. The model also supports the representation of civilian and non-combatant forces within sectors of interest.

A maximum of ten sides can be represented, and each side can be divided further into an unlimited number of factions. A faction's side allegiance is dynamically changeable during game play. Side relationship is asymmetric and also can be changed during game play.

Side names, faction names, and the color used to display the forces belonging to a side are user-configurable via the database.

1.2.2.5 Level of Detail

All processes are designed toward doctrine-neutral implementation for maximum flexibility. The basic entities represented in the model are units and targets. The user-configurable database defines unit sizes, combat systems, supply categories, and the militarily significant targets to be represented. The high resolution target systems complement the more aggregated unit structure. Units are represented at either an aggregate level of resolution, or at a high level of resolution. The database can be developed to represent, within the aggregated unit structure, the requisite detail for systems of interest. Therefore, multi-level resolution is the norm.

Air-to-air operations can be controlled as aggregate, multi-sided mission packages, but are adjudicated at the item level and use probability of hit (pH) and probability of kill (pK) factors for each mission element. Adjudication is stochastic.

Surface-to-air operations are modeled at the item level and use probability of engage (pE) and pK factors for each mission. Adjudication is stochastic.

Air-to-ground, surface-to-surface missiles, and artillery (including naval gunfire support) operations are modeled at the item level; they use pH and pK for precision-guided munitions, and target density functions for area weapon coverage. Adjudication of precision-guided munitions is stochastic, and area weapon results are deterministic.

The land warfare module uses Lanchester methodology to aggregate the effects of direct fire weapons and direct support systems not engaged in explicit fire support operations. Adjudication is deterministic.

1.2.2.6 Input

JTLS recognizes relevant terrain, weapons, movement, attrition tables, unit characteristics, and Time-Phased Force Deployment Data (TPFDD) information as input. There are no hard-coded data items; therefore, the creation of a database is complex and time-consuming when starting from scratch. The model is distributed with an example database with many reusable sections. Development time for a new database is six to eight months.

1.2.2.7 Human Participation

JTLS is an interactive model and requires human decisions to manage the processes and entities. Interface with the model is via the Graphical Input Aggregate Control (GIAC) graphical interface for order input and game graphics. Automatic input of an Air Tasking Order (ATO) is accomplished via the JTLS ATO Translator (ATOT).

1.2.2.8 Output

Each player's GIAC workstation includes a graphical display of aggregate land units, air missions, surface and subsurface ships, and High Resolution Units (HRU). The user also has available an interactive, real-time Information Management Tool (IMT). The IMT provides user configurable spreadsheet-style display from which current status information on force mission, posture, and capabilities are obtained.

JTLS users receive messages and reports concerning the movement, attrition, and logistics status of their own forces, as well as intelligence summaries and capabilities of opposing forces. The user at each workstation can select to view messages in plain language or USMTF (U.S. Message Text Format). Message outputs may be sent electronically to standard Simple Message Text Protocol (SMTP) electronic mail workstations. Electronic feeds to C4I systems, such as the Global Command Control System (GCCS), Joint Operational Tracking System (JOTS), and Joint Military Command Information System (JMCIS), have been demonstrated, and are frequently used during training exercised to feed real world Common Operational Picture (COP) displays.

Finally, graphics replay at a user-selectable time interval is supported.

1.2.2.9 Time Processing

The user specifies the desired ratio of exercise time to real time. The maximum feasible ratio is hardware- and scenario size-dependent. The design goal is a capability to maintain at least a 4 to 1 speed.

1.2.3 Limitations

JTLS modeling assumptions limit its usefulness when representing aggregate units below the battalion level, although High Resolution Units as small as individual Traffic Control Points or reconnaissance patrols are supported.

1.2.4 Hardware and Software

1.2.4.1 Computer

JTLS should operate on any open systems platform (POSIX-compliant) such as Sun Sparc stations, Hewlett-Packard workstations, or most UNIX-based systems. Backward compatibility allows operation in a DEC VAX/VMS environment. A VAX 4000-700 class machine or Sun Sparc 20 class machine with 64 Mbytes RAM, and a 2.2 Gbyte hard drive should be sufficient for medium to large scenarios (500-1000 units, 2000-5000 targets). Small scenarios can be run on Sun Sparc 5 class workstations with 32Mbytes of RAM and a 1.2 Gbyte hard drive.

1.2.4.2 Peripherals

At a minimum, the system needs one printer and one graphics suite. A GIAC graphics suite consists of a Sun LX class POSIX-compliant machine or better with 32 Mbytes of RAM and a 500 Mbyte hard drive.

1.2.4.3 Programming Languages

JTLS requires a POSIX-compliant operating system with X-Windows and Motif Toolkit libraries. For source code users a SIMSCRIPT II.5 to C translator for the target platform and a C compiler are required. ORACLE is required for database preparation.

1.2.5 Planned Improvements and Modifications

A Configuration Control Board (CCB) establishes priorities for model development and improvement. The CCB is made up of representatives from the CINCs, the services, and other authorized users of the model.The following areas have been identified as high priority improvement projects for JTLS by the governing CCB:

1. Enhance the representation of network systems (C3I, road, rail, and intelligence networks).
2. HLA Compliance.

3. Alter model to represent tessellating, multi-resolution terrain.
4. Upgrade and refine capability to link to fielded C^4I (Command, Control, Communications, and Computers) systems such as TADIL (Tactical Digital Interface Link) and CTAPS (Contingency Tactical Air Planning System).
5. Other functional requirements as specified by the Configuration Control Board.

1.2.6 Users

Users of JTLS include: Joint Warfighting Center, Warrior Preparation Center, JFCOM, USCENTCOM, USEUCOM, USSOCOM, USSOUTHCOM, USPACOM, NC3A, AUCADRE, Naval Postgraduate School, Combined Forces Command Korea, and Australian Defense Force Warfare Centre.

1.3 DOCUMENT ORGANIZATION

The remainder of *The JTLS Executive Overview* is composed of five chapters and one appendix. Chapter 2, JTLS Composition, provides a detailed overview of the model and describes the kinds of scenario data that are part of a JTLS database, the roles of JTLS Players, and how the model executes. Chapter 3, Model Capabilities, describes the functions that JTLS models. In Chapter 4, the JTLS environment is described, including hardware and software requirements. Chapter 5 is a summary, and Appendix A is a glossary of terms and abbreviations.

1.4 SECURITY

The JTLS software and system, as delivered, are unclassified. Information used in the preparation and maintenance of the scenario database may be classified. Appropriate procedures must be designed and followed for secure handling of such classified material. Care must be taken to ensure that data used in the database do not exceed the classification level set for the scenario or authorized for disclosure to personnel using the model.

Table 1.1 JTLS Documentation Suite

Air Tasking Order Generator (ATOG) User's Guide	Describes the layout, use, and logic of the Air Tasking Order Generator.
Analyst's Guide	Describes the internal workings of the JTLS combat model -- the Combat Events Program (CEP), from the point of view of the modeler.
Air Tasking Order Translator (ATOT) User's Guide	Describes the layout, use, and logic of the Air Tasking Order Translator.

Table 1.1 JTLS Documentation Suite (Continued)

C4I Interface User Manual	Describes how to use the OTH-GEM program and provide the user with detailed information on where and how the OTH-GEM obtains the information required to properly fill in the OTH-Gold message.
Configuration Management Plan	Describes activities required to establish and maintain the configuration of JTLS.
Controller's Guide	Describes the Controller's role in JTLS (monitoring the game, altering game speed, and stopping the game).
Data Requirements Manual	Describes the data required by JTLS.
Database Development System User's Guide	Describes the database development and modification tool used to build, modify, or query databases.
Director's Guide	Describes the Director's role in JTLS (scheduling resources, locating and assembling data, training, and security).
Executive Overview	Provides general description of the JTLS hardware, software, and functions.
GIAC User's Manual	Provides information necessary to understand and use the GIAC graphics support hardware and software.
GIAC Administrative Maintenance Guide	Contains step-by-step instructions to perform the administrative aspects of GIAC, including installation, configuration, and customization.
GIAC G Data System	Contains information about the G Data System, the data structures and model information.
Installation Manual	Describes how to load JTLS on a computer system and how to set system parameters.
Interface Training Manual	Provides tutorial lessons on the operation of the GIAC, MPP, IMT, and OPM (Online Player's Manual)
Lanchester Coefficient Development Tool (LDT) User's Guide	Provides detailed information on the operation of the Lanchester Coefficient Development Tool.
Player's Guide	Provides information for performing as a Player in JTLS.
Software Maintenance Manual	Provides information concerning upgrades to and maintenance of the JTLS system, and is intended to be used as a reference guide.

Table 1.1 JTLS Documentation Suite (Continued)

Technical Coordinator's Guide	Provides information needed to perform as a Technical Coordinator in JTLS (starting and restarting the game and providing computer expertise).
Version Description Document	Provides a description of the upgrades associated with each JTLS release.

2.0 JTLS SYSTEM OVERVIEW

The Joint Theater Level Simulation (JTLS) system is an interactive, multi-sided analytical tool that models a joint air, land, and naval warfare environment. It is designed as a theater-level model for use in the following areas:

1. the analysis, development, and evaluation of contingency plans and joint tactics
2. the evaluation of alternative military strategies
3. the analysis of combat systems

The model is also useful as the situation driver and combat evaluation tool for joint and international staff exercises.

This chapter first provides an overview of the wargaming process. Then it summarizes the required JTLS operating equipment suite. Finally, it presents brief descriptions of each of the JTLS programs, both major system components (e.g., the CEP) and support tools such as the Terrain Modification Utility (TMU).

2.1 THE WARGAMING PROCESS

The design and execution of the wargaming process is tied to the purpose and scope of the endeavor. Exercise or analytical objectives and resources will drive design decisions. One of four general designs normally is used:

1. Seminar wargame or analytical design
2. Open support design
3. Hidden support design
4. Distributed output design

The seminar wargame design employs a small cadre of gamers to operate the model and report results to key decision-makers. An experienced gaming cell inputs order sets—to implement a branch of a campaign plan—then runs the game at high speed in a “batch mode” until a pre-defined branch point is reached or a specified time interval has elapsed. The gaming cell then provides operational results to the seminar director to support the decision-making process. Once key decisions are made, the cycle continues with a new set of orders being input into the model. This approach requires only a few gamers; however, they must be well-trained in all aspects of the model and must maintain expertise in many warfare function areas.

An open support design places the key decision-makers—members of the target training audience—within the simulation facility. These decision-makers and/or their representatives may enter orders directly into the game or retrieve data from the model. In this mode, the model is completely open to the target training audience. This design has the advantage of not requiring many “overhead” personnel to support model inputs. However, the target training audience can become too

involved in simulation details at the expense of focus on their training objectives and their decision-making process. In addition, simplifications made during the modeling process or errors entered by game Players can detract from desired realism.

The hidden support design attempts to overcome the realism constraints by placing a response cell between the simulation facility (where the game is being operated) and the training audience. The training audience develops operation orders in their standard format, and ignores model constraints or special requirements. A subordinate response cell then processes these operational level orders into game-level directives. During execution, the response cell monitors reports produced by the model and may monitor simulation outputs over organic command and control systems. The response cell reviews all output to ensure errors are corrected before data are transmitted to the training audience. In this manner, the simulation is hidden from the training audience. However, this scheme requires "overhead" personnel to operate the JTLS workstations and additional personnel to establish and maintain the response cells.

A distributed output design attempts to combine aspects of the Open and Hidden designs to interface the model with established C^3I (Command, Control, Communications, and Intelligence) systems. This design permits key decision-makers to send orders and monitor results over their organic, wartime command, and control systems. Their orders are processed into game directives by a response cell (as in the hidden support design). However, output from the model is broadcast directly to elements of the training audience over their organic C^3I. For example, the Air Operations Center (AOC) may establish a Tactical Digital Interface Link (TADIL) from the JTLS model to an organic battlespace management system. In addition, USMTF (U.S. Message Text Format) messages can be transmitted from the game over a local area network (LAN) to an interface with Theater communications systems. When coupled with order input modules like the Air Tasking Order Translator (ATOT), this design structure will provide powerful and flexible support for training exercises.

All of these designs are supported by five key staff positions: the Exercise Director, the Senior Controller/Exercise Controller, the Technical Coordinator, the Computer Systems Manager, and the Players.

1. **The Exercise Director** plans and administers the wargaming exercise.
2. **The Senior Controller/Exercise Controller** monitors the progress of the campaign and uses JTLS model tools to shape the electronic battlespace to meet operational requirements or training objectives as specified by the Exercise Director.
3. **The Technical Coordinator (or Tech Control)** starts and stops the game, monitors all computer resources needed for the simulation, and provides technical support for the JTLS game.
4. **The Computer Systems Manager** configures the computers and coordinates system software changes and hardware maintenance.

5. **The Players** input game orders and monitor the status of assigned forces. Players may have command authority over all forces on their side or can be limited in who they may command or in the type of functions they may perform. JTLS requires at least one Player per Force Side. There are generally six distinct types of Players. However, JTLS provides the exercise planning staff the capability to develop other specific Player types that combine any or all of the above functions. This is done by creating specific Player order menu definition files tailored to exercise requirements. For example, a particular exercise might require a Player who had access to some of the AIR-related orders as well as selected LOGISTICS and INTEL orders. The six commonly used Player types are:

    a. A **Commande**r can perform all Player functions.
    b. A **Ground Player** can issue directives required to manage the scenario's ground forces only.
    c. An **Air Player** can issue Air Mission directives only.
    d. A **Naval Player** has access only to those orders which are required to fully manage all naval and amphibious capabilities modeled in JTLS.
    e. An **Intelligence Player** issues orders only to intelligence collection assets, processes information gathered by organic resources, and passes information to other interested Players.
    f. The **Logistics Player** is limited to establishing stockage objectives, directing resupply operations, and controlling convoys and supply networks.

2.2 JTLS OPERATING EQUIPMENT

JTLS consists of several programs that are closely related and integrated into a system allowing users to create the needed databases, run the game, and analyze the results. The current version is designed primarily for execution on UNIX-based systems on the following platforms and operating systems:

- Sun Ultra (Solaris)
- HP workstations (HP aix)

The following equipment requirements were established during stress testing at the Joint Warfighting Center. The stress test database consisted of approximately 1,500 units, 5,000 targets, 8 sides, and 20 factions. Throughout the test, game speeds of 4-to-1 or faster were maintained consistently. Although any POSIX-compliant hardware may be substituted, the initial distribution and testing targeted the Sun Ultra platforms (or equivalent). JTLS has been run successfully on DEC VAX/VMS, Alpha Ultrix and HP platforms. However, we are currently not supporting them, because there are no users requesting that JTLS be maintained on these machines. We expect that we will be supporting JTLS for Windows NT by October 2000.

- Combat Events Program (CEP) - Required - 1
- Ultra 60
- 512 Mbytes to 1 Gbytes RAM

- 9.1 Gbytes internal storage (which includes the space required for the operating system)
- 4 mm tape drive
- Ethernet port
- 21-inch color monitor

1. G-Data Sever (GENIS) and Controller Workstation - Required - 1
   - Ultra 60
   - 512 Mbytes to 1 Gbytes RAM
   - 9.1 Gbytes internal storage (which includes space required for the operating system)
   - Ethernet port
   - 21-inch color monitor
2. Map Server - Optional - 1 required only if displaying digitized maps
   - Ultra 60
   - 128 Mbytes RAM
   - 9.1 Gbytes storage (approximately 110 Mbytes required per map)
   - CD ROM drive
   - Ethernet port
   - 21-inch color monitor
3. Player Workstation - Required - Minimum 1 per side
   - Ultra 10
   - 128 Mbytes RAM
   - 9.1 Gbytes internal storage (which includes the space required for the operating system)
   - Ethernet port
   - 21-inch color monitor
   - three button mouse required to use the new IMT
4. Laser Printer - OPTIONAL - Minimum of 1. One per work area is recommended.
5. Miscellaneous - Ethernet cable and connectors

Smaller databases such as might be used for training, testing, experimentation, and demonstration will operate successfully on reduced platforms. For example, the CEP and GENIS software will operate satisfactorily when both run on a single Ultra 60 platform.

2.3 JTLS GENERAL STRUCTURE

Figure 2.1 depicts the general structure of JTLS and the relationship among its major programs. Brief descriptions of each subsystem are provided in the remaining sections of this chapter. Refer to *The JTLS Technical Coordinator's Guide* and *The Player's Guide* for the individual programs for more in-depth discussions of data files and programs.

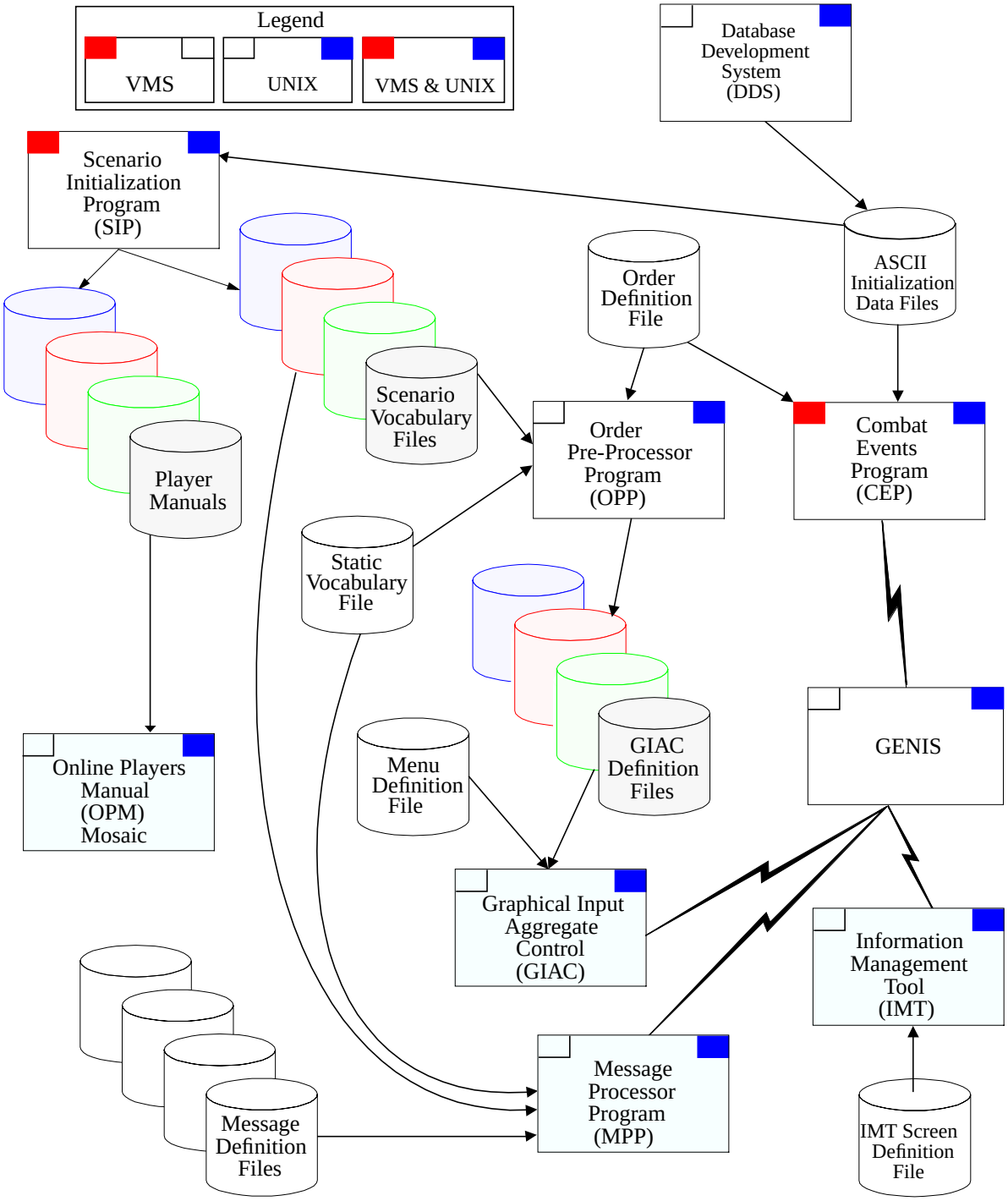

Figure 2.1General Structure of JTLS

In Figure 2.1 programs are coded according to their current hosting capability (see the legend in the upper left corner of the figure). Seven programs execute only on a UNIX system and two (Combat Events Program [CEP] and Scenario Initialization Program [SIP]) can be hosted either on VAX/VMS or on UNIX systems. In the current JTLS release, there are no programs that execute only on a VAX/VMS platform.

Several JTLS interface and support programs can be hosted on x86 Personal Computers (PCs) running PC Solaris. The programs (described in the following sections) that can run on a PC include: GIAC, ATOG, ICP, ICPLogin, IMT, MPP and TMU. A JTLS release includes executables that have been compiled for PC execution for each of these programs.

2.4 SCENARIO PREPARATION AND SUPPORT TOOLS

The JTLS scenario preparation and support tools are used to access and read the JTLS ASCII initialization data files, provide information about data consistency and validity, manipulate the data, and then write new, updated versions of the ASCII data files. Since the interface between data preparation and game execution is via editable ASCII files, knowledgeable personnel also can access the initialization files with any text editor. Accessing the data files in this manner is recommended only for experienced personnel familiar with the format of the data files.

2.4.1 Database Development System (DDS)

The DDS is the primary JTLS database development and modification tool. It is used to build a new database, to modify an existing database, or to query an existing database for specifically filtered information. For example, the DDS can be used to obtain a list of units in the database by type (i.e., by the Tactical Unit Prototype, or TUP, that is used). The DDS is an application of the ORACLE7 Server (a relational database management system), and was built using the ORACLE Developer/2000 tool. The ASCII data files that define the initialization database for a selected scenario are uploaded to fill a set of ORACLE tables designed to be compatible with the JTLS database structure. The DDS user accesses these tables to modify or query the data they contain. Then, when modifications are complete, the data are downloaded to create a new set of JTLS initialization data files for that scenario.

The DDS is started by first selecting option 1, Prepare or Alter a Scenario Database, from the JTLS Main Menu. Then, from the resulting JTLS Database Preparation Menu, option 1, Access the Database Development System Menu, is selected.

2.4.2 Scenario Verification Program (SVP)

The SVP is not explicitly shown on the JTLS system diagram depicted in Figure 2.1. It is part of a family of tools represented as the SIP. The purpose of the SVP portion of the SIP is to verify that the data entered for a given scenario are compatible by checking for consistency among variables. The SIP reads the scenario database files that are used by the CEP, and holds the data in the same data structures used by the model during game execution. This makes all necessary consistency checking

efficient and accurate. For example, it ensures that naval units are placed on water terrain hexagons and that ground units are placed on ground terrain hexagons. The output from this program lists the errors and possible inconsistencies that were noted in the data. The SVP is started by selecting option 2, Verify an Existing Scenario Database, from the JTLS Main Menu.

2.4.3 Terrain Modification Utility (TMU)

This utility program is used to modify JTLS hex-based terrain files. The program displays the user-selected terrain database superimposed on the selected vector map. The user can change the scale and re-center to focus the display on specific areas of the map and display the hex grid. Then the individual hex attributes (terrain type, barrier type, and hex elevation) can be viewed and modified. The TMU is not shown in Figure 2.1.

2.4.4 Lanchester Development Tool (LDT)

This program assists in the development of Lanchester coefficients which are used to assess the results of force-on-force land combat in JTLS. The user inputs the desired outcome of a battle of a specified length, and the LDT generates a suggested table of Lanchester coefficients. The LDT also has a verification function which allows the user to view in tabular format the results of a long-term battle between two or more units. The LDT is not shown in Figure 2.1.

2.4.5 Convert Location Program (XCONVERT)

The Convert Location Program is a tool that accepts location coordinates in:

- Decimal or text latitude/longitude
- Hex coordinates
- Universal Transverse Mercator (UTM)
- Military grid

Once a valid location is entered, the program converts it to its equivalent in the other three coordinate systems. All four representations are displayed. The Convert Location Program is not shown in Figure 2.1.

2.5 SYSTEM SETUP AND INITIALIZATION PROGRAMS

These programs are used to prepare JTLS to execute with a specific scenario.

2.5.1 Scenario Initialization Program (SIP)

The SIP is one of the programs that must be executed to prepare a scenario that has not been run previously for game start. One of its primary functions, the SVP, already has been discussed. Its remaining functions include:

1. Determine that all the data files defining the scenario exist.

2. Create the proper directory structure to hold game runtime data files.
3. Copy all scenario initialization data files into the game directory.
4. Create data files needed by other JTLS processes—for example, GIAC order definition files (using the Order Pre-Processing Program [OPP]), and menu definition files.
5. Verify playing surface map file selection.

SIP must be re-run for a scenario:

1. whenever the initialization data have changed;
2. whenever definitions in the static vocabulary file have changed;
3. after a new version of GIAC is installed; and/or
4. whenever the order definition file has changed.

2.5.2 Interface Configuration Program (ICP)

The ICP is an interactive program that allows the user to define the specifications for each game process that can be started for a particular scenario: OPMs (Online Player Manuals), ATOs (Air Tasking Orders), IMTs (Information Management Tools), MPPs (Message Processor Programs), GIACs, GENISes, and the CEP. The program uses a Graphical User Interface (GUI) to allow the user to edit the default (determined when the SIP was run) process configuration. The data required to define a process in the game configuration differ with the type of process. Process definitions include process name, startup password, parent process, execution host, Force Side, and so on.

The ICP usually is run before game start to tailor the configuration to exercise needs. However, it can be run while JTLS is executing. For example, the ICP would be run to define the specifications of a new GIAC (and its associated MPP and IMT) that was to be added to the pre-start system configuration and brought online. The ICP is not shown in Figure 2.1.

2.5.3 Interface Login Program (ICPLogin)

The Interface Login Program (ICPLogin) is a program designed to facilitate the procedures to start game processes (GIACs, for example). All game processes, except the GENISes, normally are started using this program. The ICPLogin Program is initiated by selecting an option on the JTLS Main Menu. Thereafter, to start a process the user simply single-clicks on the appropriate “button” on an option selection bar and follows the prompts. After a process is identified and selected, the ICPLogin Program reads a data file that was created by the ICP, creates the required specific configuration file, and initiates the start. The ICPLogin program is not shown in Figure 2.1.

2.6 THE COMBAT EVENTS PROGRAM (CEP)

The CEP is the central program of the JTLS system, the combat model. It determines all of the actions and interactions among the air, land, and naval forces defined and modeled for the specific scenario being run. The CEP creates, maintains, and reports the current status of the warfare environment being modeled. The CEP can model up to ten sides or coalitions in any given scenario.

Each side can specify its combat relationship (friendly, enemy, suspect, or neutral) with each of the other represented sides. Only one CEP is allowed for a given scenario on any individual machine or network during JTLS execution.

The CEP communicates via a TCP/IP socket connection only with the single Primary GENIS process. The Primary GENIS receives an initial data download and periodic updates from the CEP. It, in turn, communicates with GIACs, MPPs, IMTs, and Secondary GENISes that are assigned to it. Each GENIS maintains its own up-to-date game database and communicates with the processes immediately below it in the information tree structure.

Player inputs to the game are in the form of orders entered at a GIAC and transmitted to the CEP for processing via one or more GENISes up the tree. Players receive game information from the CEP (via GENISes down the tree) in the form of GIAC graphics updates, MPP messages, and IMT tabular data display updates.

2.7 PLAYER INTERFACE PROGRAMS

2.7.1 Graphical Input Aggregate Control (GIAC)

The GIAC is the active interface between the player and the CEP. The GIAC provides a series of order templates. The user enters the data to complete each mandatory field. The GIAC verifies that the entries are acceptable before sending the order to the CEP.

The same GIAC used to enter and send orders to the CEP is used to display the spatial information required to understand the current status of your forces and your perception of enemy forces. GIAC is an X-Windows based graphical display system that accesses its data from its own network-based external database. CEP messages are sent to GIAC using a protocol message format. These messages are sent to the GIAC by way of the GENIS Data Server (GDS), which in turn fills GIAC’s shareable network database. Figure 2.2 shows a typical GIAC display.

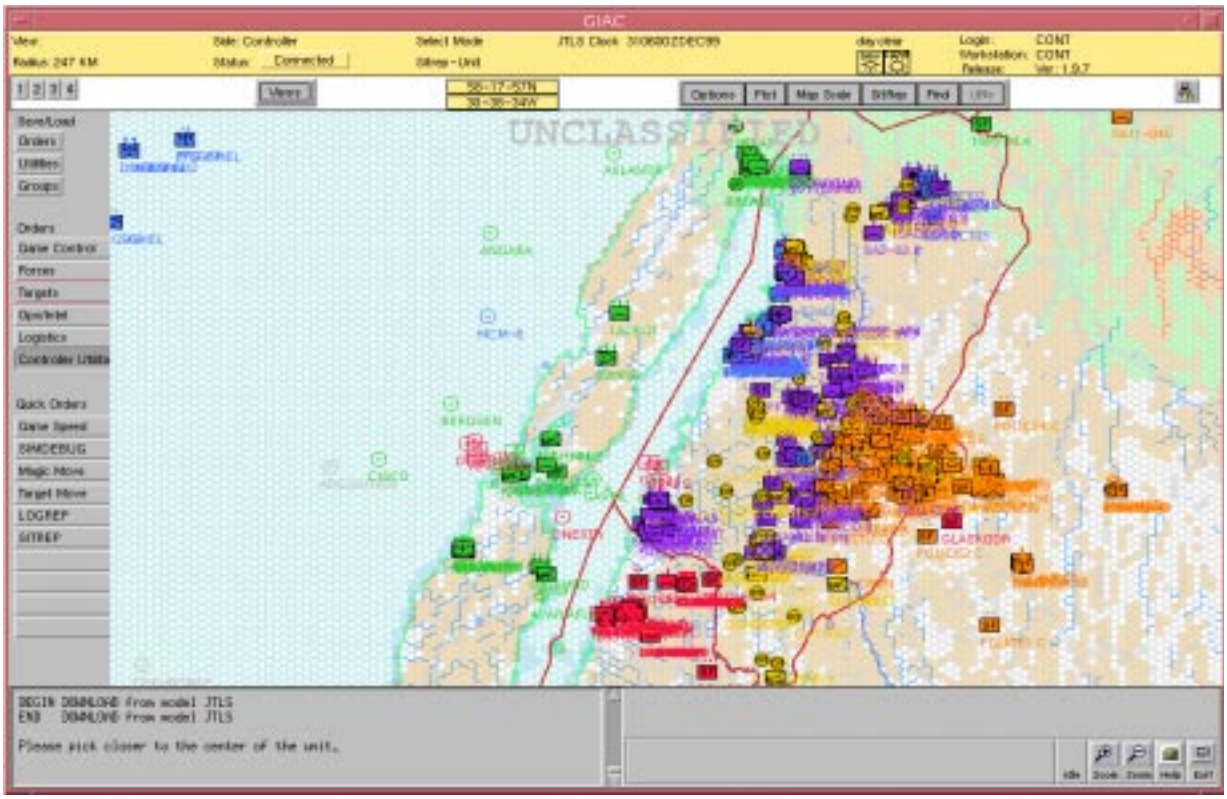

Figure 2.2 Typical GIAC Display

2.7.2 Air Tasking Order Generator (ATOG)

The ATOG (not shown in Figure 2.1) is designed to assist an air player in creating both offensive and defensive Air Mission orders. The player specifies target areas, target priorities, available aircraft resources, and the command's desired apportionment goals for the selected ATO period. The ATOG uses this guidance, the player's perception of the battlefield, and the current unit logistical status to automatically create a set of coordinated air orders. The player is allowed to view or change individual order parameters prior to sending the generated orders to the CEP.

2.7.3 Air Tasking Order Translator (ATOT)

The ATOT (not shown in Figure 2.1) translates a USMTF ATO—generally produced by the USAF's CTAPS (Contingency Tactical Air Planning System) ATO generator program—into JTLS Air Mission orders. You must obtain the ATO in the specified Joint format. Technical Control personnel will load the file into the correct directory on the computer. The program then permits you to review the results of the translation and affords a limited opportunity to modify some taskings. This

tool permits wholesale adoption of orders created by a functioning Air Operations Center (AOC). However, some ATO missions do not translate automatically. Hence, as an air Player you will be required to input these orders on your GIAC.

2.7.4 Message Processor Program (MPP)

Messages from the CEP are sent to the MPP, and can be displayed at each individual Player workstation in either English language or USMTF format, with either latitude/longitude or geographical reference coordinates. Figure 2.3 shows a typical MPP window. This tool allows you to read, print, or e-mail these messages. There are two basic types of JTLS messages:

1. A message can be addressed specifically to an MPP. Only the addressed MPP receives the message. If the MPP is not executing, the CEP queues the message until the MPP is ready to accept messages.
2. A message can be addressed to a general side and function. This is known as a broadcast message and the message is sent to each MPP on the specified side. The Player has control over which function messages should and should not be displayed on his MPP.

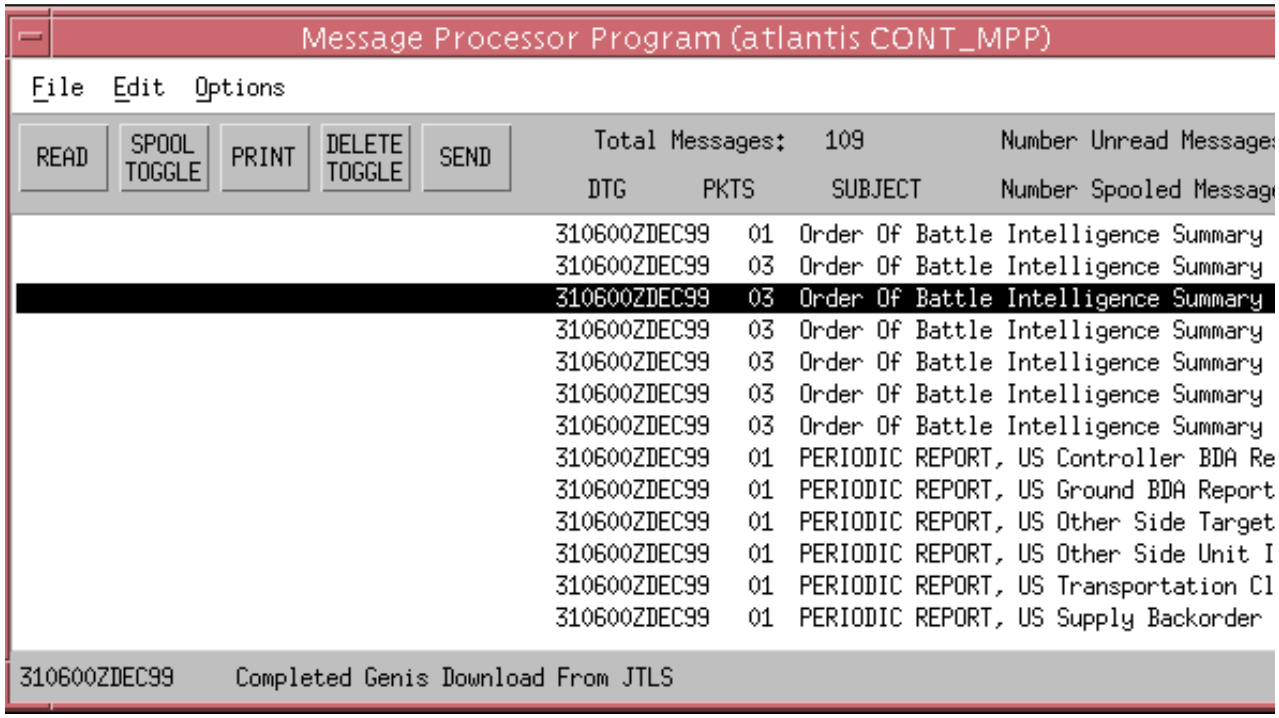

Figure 2.3 Typical MPP Display

Generally, JTLS reports current status information to the GIAC and IMT. A message is created under a limited number of circumstances. A message is generated when:

1. you submit a request for detailed forces status information;
2. the CEP needs to inform you of a problem with an order or one of the forces under your command; or
3. a summary of the action taken within the last reporting period is generated.

2.7.5 Information Management Tool (IMT)

The IMT is an interactive status board that allows you to display accurate current force status information about your own forces and current perceived information that your side has collected about foreign forces. This information is presented in tabular form and is shown in a number of different window displays that you can open. Figure 2.4 is an example of one of the IMT windows available to you.

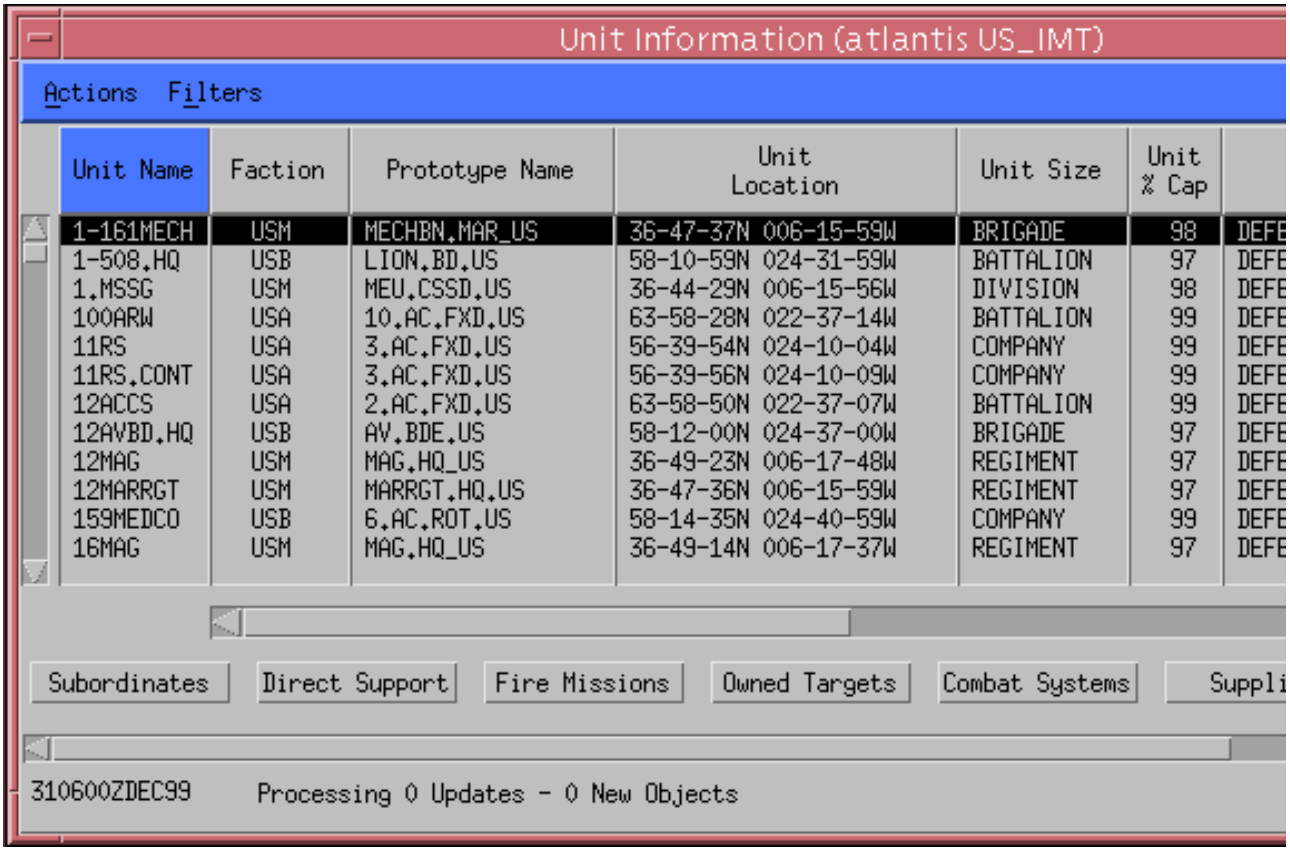

Figure 2.4Typical IMT Display

Several IMT display windows can be open at any one time at a Player station. These present information, filtered by you in a number of ways, on current operations, the current capabilities of your units and your targets, the status of your Air Missions that are flying or scheduled to fly, and recent intelligence reports collected for all foreign forces.

2.7.6 Online Player's Manual (OPM)

The OPM provides access to a series of text files which contain formatted scenario initialization data. An OPM can be generated from either the game start database, or from the database associated with a checkpoint. You have access to this information using a Hyper Text Markup Language (HTML) browser, also known as a web browser. With an HTML browser you can move through the files from subject to subject by using your workstation mouse. It is important to remember that the data contained in the text files are static, describing the database from which they were generated. They are not continuously updated as the game progresses.

2.8 WARFARE FUNCTIONS MODELED

The CEP simulates the execution of air, ground, intelligence, logistics, and naval activities. A summary of these functions is provided in the following paragraphs. Details on how each function is modeled are found in the remaining sections of *The JTLS Analyst's Guide*.

1. The air function models:
   a. Airborne Warning and Control System (AWACS)
   b. Electronic Combat (EC)
   c. Air refueling
   d. Escort
   e. Wild Weasel (WW)
   f. Defensive counter-air (including ground and airborne alert)
   g. Surface attack
   h. Close Air Support (CAS) (including ground and airborne alert)
   i. Reconnaissance, both armed and unarmed, including specifications for DSAs (Directed Search Areas)
   j. Airdrop of units or supplies
   k. Airlift of units or supplies
   l. Air Mission Packages
   m. Air emplacement of land or sea mines
   n. Anti-Submarine Warfare
   o. Orbiting Air Ground Missions (OAG)
   p. Real Time Commitment of OAG and diversion of surface attack missions
   q. Manual commitment of air missions to intercept enemy air missions
   r. IFF (Identification, Friend or Foe) including Unknown identification
   s. Detailed Air-to-Air and Surface-to-Air Rules of Engagement (ROE)
   t. Establish links with other factions to share air detection information

u. Search and Rescue (SAR) operations for downed pilots
v. Integrated Air Defense System (IADS) operations

2. The ground function models:
   a. Attrition caused by direct fire
   b. Attrition caused by indirect fire
   c. Movement
   d. Attack
   e. Hasty defense
   f. Prepared defense
   g. Delay
   h. Withdrawal
   i. Delaying effects of, and attrition caused by, land mines
   j. Close Air Support
   k. Command, Control, and Communications (C3)
   l. Attrition and delays caused by nuclear and chemical contamination
   m. Military engineering, including Bridge construction
   n. Attachment, detachment, and reconstitution of units
   o. Emplacement of mines by artillery, air drop, or unit action
   p. On-order destruction and repair of targets
   q. Special Operation Forces
   r. Multi-Faction coalitions
   s. Detailed Ground Combat/Surface ROE
   t. Civil Affairs and PSYOPS (Psychological Operations)
   u. Detachment of small units (High Resolution Units, or HRUs) to carry out a variety of tactical operations
3. The intelligence function models:
   a. Periodic intelligence via the Periodic Summary
   b. Directed intelligence through HRUs, airborne reconnaissance, and unit organic resources
   c. Spot/mission reports from ground forces and airborne missions
   d. Separate perception of the battlefield for each Force Side
   e. Selective sharing of Intelligence between Force Sides
   f. Partial Intelligence of targets and units
   g. External/National asset resources
   h. Communications networks
4. The logistics function models:
   a. Effects of logistics on combat capability including maintenance and return to service for Combat Systems
   b. Automated resupply (e.g., stockage objective, reorder level, and backorder)
   c. Multiple support unit assignment based upon supply category
   d. Player-directed supply, resupply, and cross leveling for units
   e. Movement of supplies by rail, barge, or truck
   f. Pipeline operation
   g. Caching and recovery of own supplies and capture of Enemy supplies

h. Port operations for inter- and intratheater air and sea movement
i. Transportation networks (linking bridges and tunnels)
j. Random equipment failures

5. The naval function models:
   a. Carrier-based air activities as listed in the air function
   b. Sealift
   c. Search radar coverage
   d. Surface-to-Surface missile firing and naval gunfire
   e. Naval reinforcing fire
   f. Task organization from multiple Factions and multiple Force Sides
   g. Amphibious pickup/extraction and assault
   h. Mine warfare operations, including laying, sweeping, and casualties
   i. Task organization (Formation) movement, including merging formations
   j. Submarine operations
   k. Area patrol
   l. Ocean depth, depth zones, and the effects of depth on operations

In addition, the JTLS CEP models the effects of disease on personnel. Personnel contract diseases and either die or recover. The disease status of units is reported as part of the Periodic Reporting process.

2.9 EVENT-DRIVEN SIMULATIONS

JTLS is a simulation model of a joint campaign at the theater level. As such, it simulates the key aspects of the air-land battle and supporting naval operations.

Simulations may be characterized as continuous or discrete-time. JTLS is a discrete-time simulation. Discrete-time simulations may be further characterized as time-stepped or event-driven. In event-driven simulations, state changes occur at specified times at which interactions between system components occur.

The basic components of a dynamic system are activities. There are two important characteristics of activities:

1. They take time.
2. They potentially change the state of the system.

When constructing a system model, one must identify and represent the activities in a way that enables the simulation to reproduce the time-dependent behavior of the system simulated.

Activities must be modeled so that the system state changes properly when each activity occurs. This requirement imposes additional requirements for correctly modeling the characteristics of activities and for sequencing the simulated execution of activities so that their order of performance within the model corresponds to the order in which the same activities occur in the real system.

An activity in a system is bound by two instantaneous events: when the activity starts and when it stops. The event is the simplest component of an activity description. There are two main properties of an event:

1. It occurs at some instant of time.
2. The occurrence is instantaneous.

The changes in a system that occur when an activity starts or stops are associated with events rather than activities. As these events cause all significant system state changes, the passage of time between events need not be accurately followed. Instead, the passage of simulation time is driven by the sequence of events, advancing always to the time of the next significant event.

2.10 SIMSCRIPT

2.10.1 Why SIMSCRIPT?

Event-driven simulation was chosen for JTLS for two reasons:

1. The key processes of theater-level, air-land battle are most easily visualized as collections of discrete events.
2. Event-driven simulation is relatively fast and makes efficient use of computing resources.

The main routine-subroutine structure of most high-level programming languages is not suitable for event-driven simulation because of the awkward way they handle activities that occur simultaneously in simulation time. Furthermore, the software mechanism required to maintain synchronization of simulated time with the pace of events is complex and would be most useful as a programming system utility.

For these reasons a special-purpose, discrete-event simulation language called SIMSCRIPT was chosen to implement JTLS. SIMSCRIPT has built-in mechanisms for handling both simultaneous events and simulation time. In addition, the SIMSCRIPT world view is that of a discrete-event world, and the language has many other features that lend themselves especially well to event-driven simulation.

2.10.2 The SIMSCRIPT World View

The SIMSCRIPT world is populated with entities and sets. Entities are characterized by attributes. A set is a collection of entities sharing a logical association. Thus a military unit such as a division may be an entity. Among its attributes could be its name (such as 82.AIRBORNE), its average ground speed over open terrain, and its capacity to carry supplies.

An entity may be both a member of sets and an owner of sets. Thus the entity 82.AIRBORNE might be a member of the CONFLICT SET—the set of all units in the game. This entity also might be the owner of a HEADQUARTERS SUBORDINATE SET—the set of all units subordinate to it (e.g., a division artillery battalion or an engineer battalion).

A very special kind of entity is the event, the simplest component of an activity description. Events are managed by a Future Events Set that is provided by SIMSCRIPT. Each event is also associated with a subroutine, whose execution may be scheduled to occur at a specific simulation time in the future.

An example of an event in JTLS is the ASSESS COMBAT event. This event occurs at specified intervals and calls a number of subroutines that contribute to the evaluation of casualties over a given period of time. It is first scheduled by the routine starting the simulation. Thereafter it schedules itself.

The simulation must be started by the scheduling of one or more future events. Its continuation depends on the existence in a Future Event Set of at least one pending event.

In addition to entities and sets, SIMSCRIPT also makes use of arrays. The most basic form of array is a list. Another common form of array may be visualized as a table. In SIMSCRIPT, arrays may be linked to entities by means of a specialized attribute of the entity called a pointer. Thus the array (in this case a table) that holds all the information about the Combat Systems of a unit is linked to the unit by the COMBAT SYSTEMS array pointer. Information is recovered about the status of a unit's Combat Systems merely by retrieving the Combat Systems pointer attribute of the unit and, using the pointer, retrieving the COMBAT SYSTEMS array of the unit.

2.10.3 Simulation Time

The timing routine is at the heart of a discrete-event simulation. The timing routine ties together the entire collection of events that make up the simulation. Pseudocode 2.1 describes the timing routine. Note that events must be on the Future Events list prior to entry into this routine or the simulation will terminate immediately. It is natural to assume that the execution of one event may activate other events (as does ASSESS COMBAT) and thus perpetuate this sequence for some time. Termination should occur for algorithmic reasons.

```
Start Simulation

| Loop while any event is on Future Events List
|       |Select event with earliest time
|       |Update simulation time to time of event
|       |Remove event from Future Events List
|       |Execute event routine
| End loop
| Exit
```

Pseudocode 2.1 SIMSCRIPT Timing Routine

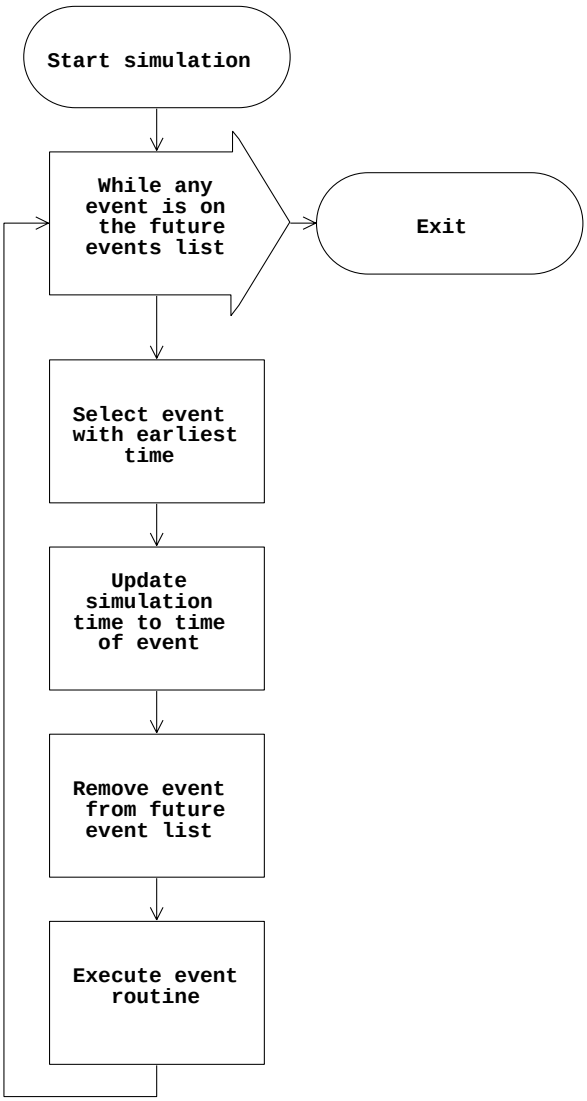

Chart 2.1. SIMSCRIPT Timing Routine

2.11 SYNCHRONIZING GAME TIME TO REAL TIME

The SIMSCRIPT timing routine ensures that the next event processed is the event with the earliest time. The timing routine executes the next event as soon as the last event finishes processing. This typical SIMSCRIPT sequence is diagrammed in Pseudocode 2.1 and represented in Chart 2.1.. The procedure of immediately executing the next event cannot be effectively used in an open game in which decision-makers are interacting with the simulated system.

JTLS must synchronize game time to real-world clock time. This allows the Players to make decisions and manipulate their forces in a realistic, time-constrained manner. The synchronization process is based on a parameter representing the ratio of game time to real time. This parameter, GAME RATIO, can be any non-negative value and can be changed by the Game Controller as JTLS executes. Table 1-1. lists possible game ratios and their meanings.

Table 1-1. Game Time Ratio Possibilities

GAME RATIO	RATIO MEANING
0.0: 1	Game time is stopped. As far as the model is concerned, time is not passing. The model will accept Players' orders. Since time is not passing, any events or orders that should take place in the future will be held until the game ratio is increased.
Less than 1.0: 1	Game time is passing at a slower rate than real time. Players have a longer time to make decisions than would be available in a real situation. For example, with a game ratio of 0.5, 30 minutes of game time would pass for every hour of real time.
1.0: 1	Game time and real time are the same. For every hour that passes in the simulation, one hour of real time will pass.
Greater than 1.0: 1	The game is operating at a faster-than-real-time ratio. For example, with a game ratio of 4.0, four hours of game time would pass for every hour of real time.

The SIMSCRIPT timing routine always will execute the next event immediately. This timing routine process cannot be changed. Therefore, to synchronize the simulated game time to real time, execution of the SIMSCRIPT timing routine is delayed until enough real time has elapsed. The CEP delays execution time of the SIMSCRIPT timing routine by a stopping procedure known as hibernating. The CEP hibernates or sleeps just prior to entering the SIMSCRIPT timing routine. The CEP remains in the hibernation state until it is appropriate to update the game clock and execute the next event.

Pseudocode 2.2 diagrams this procedure and can be compared to the typical SIMSCRIPT sequence diagrammed in Pseudocode 2.1. When it wakes up from the sleep state, the CEP enters the SIMSCRIPT timing routine and processes the next event chosen.

The CEP uses the internal system clock of the computer on which it is executing to determine the real time; a SIMSCRIPT-provided variable to determine what the game time is; and its record of the desired game ratio and the starting time of that game ratio to determine whether the game is achieving the desired game ratio. If the game is not meeting the desired game ratio (i.e., it is behind), then the next event always should be executed immediately. If the game is achieving the desired game

time ratio, then the CEP may be able to wait to execute the next event, depending on when that event should occur. The wait is accomplished using a system-dependent call, which is specified in the Preamble and determined when the program is compiled. Pseudocode 2.2 depicts the logic that is used.

```
Loop while any event is on the Future Events List
|       |SYNCHRONIZE TIME
|       |       |given Time of Next Event
|       |       |Yielding Time to Check Again
|       |If the GENIS is Not connected
|       |       |Try to connect to the TCP/IP socket
|       |       |If the attempt is successful
|       |       |       |If the Game Ratio GT 0.0
|       |       |       |       |Send 'Game Running at Game Ratio' Message to GENIS
|       |       |       |Else
|       |       |       |       |Send 'Game Paused' Message to GENIS
|       |       |       |Endif
|       |       |Endif
|       |Endif
|       |If the GENIS is connected
|       |       |Until there are no more messages to process
|       |       |       |Read a message from the socket
|       |       |       |Process the message
|       |       |Loop
|       |Endif
|       |Determine EXPECTED TIME given the GAME RATIO
|       |If EXPECTED TIME is later than Time of Next Event
|       |       |Time to Check Again = Time of Next Event
|       |       |Execute the next event
|       |Else
|       |       |Time to Check Again = TIME.V
|       |       |Hibernate for 2 Real Time seconds
|       |Endif
End loop
```

Pseudocode 2.2 Time Synchronization in JTLS

The SIMSCRIPT timing routine maintains the Time of Next Event by selecting the event from its Event List with the earliest scheduled execution time. If there is no next scheduled event, the execution of the simulation stops. The returned argument, Time to Check Again, specifies for

SIMSCRIPT the time to which game time should be advanced. If there is an event scheduled at that time, the event is executed; if not, SYNCHRONIZE TIME is called again. The messages that arrive at the CEP from the GENIS via TCP/IP socket are Connect Requests from external processes such as the GENIS itself, GIACs, MPPs, and IMTs; Player Orders being passed to the CEP; and Disconnect Notifications from external Processes.

The EXPECTED TIME is the game time (TIME.V) that the CEP would have reached if the CEP were exactly keeping up with the Controller-specified Game Ratio. It is determined by computing the amount of wall clock (real) time that has passed since the Game Ratio was last set, multiplying that value by the Game Ratio, and adding the resulting time to the Game Time at which the game ratio was last set.

2.11.1 Current Game Time Updates

Even though game time is not advancing between events, the Players must be able to see time advancing continuously. This is done by periodically sending the current game time to the external processes. This is accomplished using a special event, the SEND TIME event, whose only function is to send the current game time to the GENIS so that it can be forwarded to all interface programs. The GIAC and the MPP both display the game time as of the last time that it was sent. This usually will be earlier than the real current game time except when the game ratio is zero. The updated time is sent to the interface programs periodically, based on an input data parameter, TIME BETWEEN DISPLAYS, and each time the game time is sent, the next SEND TIME event is scheduled.

2.11.2 Player Order Processing

When a GIAC sends an order, it uses the TCP/IP protocol to pass the information about the order to the GENIS, which passes the order to the CEP. Each time the CEP completes the processing of an event and returns control to the SIMSCRIPT event-controlling routines, the CEP routine SYNCHRONIZE TIME is called. Before the routine begins to perform the computations for synchronizing time, it reads all the inbound messages from the GENIS. Once the game is up and running and the GIACs are connected, most of these messages are Player orders. Based on the data in the message, the appropriate routine to process the message is called. Each player order has a routine specified as the appropriate routine to process the data for the order.

3.0 MODEL CAPABILITIES

This chapter provides an overview of the JTLS functions. It is organized into six sections: force control, ground combat, logistics, air combat, naval combat, and C^3I.

3.1 FORCE CONTROL

3.1.1 Command Authority

Players interact with the simulation by sending orders to units over which they have either primary or shared authority. JTLS provides the commander of each Force Side with the ability to manage the allocation of command authority among the Players on that side. At game start, one Player on each side has primary authority over all units on that side. Thereafter, ordering authority over units, primary or shared, can be granted or revoked for individual Players.

3.1.2 Force Side Relationships

Each Force Side in the game has a relationship (Friendly, Neutral, Suspect, or Enemy) with each other Force Side. At the start of a game, each side has a relationship to each other side that is specified in the database for each side. Relationships can be changed either directly (by Player order) or indirectly (as a result of an attack). Force Side relationships determine how units react to units of other sides. For example, a unit will only kill a discovered convoy if it perceives that the convoy came from a unit on a side for whom the relationship is “Enemy.”

3.1.3 Rules of Engagement (ROE)

JTLS models the concept of ROE, which allows the representation of situations prior to hostilities, when units and aircraft are operating in close proximity, but are not fighting. It also allows play to easily escalate to limited exchanges by some units without all-out exchange. It accommodates the situation in which some unknown air missions are to be engaged while others are to be intercepted without attack. It permits the situation in which Foreign objects are to be engaged only if they come within a specified distance of Friendly assets. Finally, ROE algorithms allow for automatic firing of naval SSMs and torpedoes.

The ROEs represented in JTLS are Ground/Surface, Surface-to-Air, and Air-to-Air. Each unit has a specific ROE value for each opposing side for each of these categories. The ROE settings are:

1. No Fire, the unit is not allowed to initiate combat, return fire, or defend itself.
2. Hold Fire, the unit may not initiate combat, but can defend itself.
3. Weapons Tight, the unit may engage objects within a specified range that it perceives as Enemy.
4. Combat Approved, the unit may engage Enemy objects or objects of a specified side within a given range.

3.2 GROUND COMBAT OPERATIONS

The JTLS ground module performs the following basic ground combat functions:

1. Establish new routes for ground movement
2. Perform administrative moves
3. Attack, Defend, Delay or Withdraw
4. Order explicit indirect fire support (and the associated capability to cancel such orders)
5. Emplace land mines by unit, air mission, or artillery
6. Maintain ROE settings
7. Clear land mines
8. Repair targets
9. Destroy targets
10. Order reinforcing fire
11. Perform operations using High Resolution Units (HRU)

Ground close combat between and among aggregate units is modeled by the use of mixed, heterogeneous, time-stepped Lanchestrian difference equations. Separate equations are used for casualties caused by direct fire combat systems and indirect fire systems. The amount of attrition is affected by environmental conditions such as: weather, night or day, and terrain. Engagements involving HRU's are modeled using explicit representation of the units capabilities to fire weapons and detailed assessments of the results.

3.2.1 Ground Force Movement and Deployment

Ground movement in JTLS follows a path of hexagons, with the moving unit "jumping" from point to point within a hexagon or between hexagons at appropriate time intervals. The paths followed may either be minimum time or minimum distance, with the actual path optimized by the model. Movement paths are specified by Players as Ground Routes. Movement delays caused by route congestion or Enemy action (mining, nuclear or chemical contamination, artillery, and air strikes) are also simulated in the model. Minefields delay moving units and cause attrition.

Ground units can move either administratively or tactically. An Attack, Delay or Withdraw directive (Player order) results in a tactical move. Any other order that directs a unit to move to a location (including a Move directive) causes the unit to perform an administrative move. An administrative move can be directed for a single unit or a group of units, and is usually faster than a tactical move.

One of the attributes of a Tactical Unit Prototype is the number of hours that it can maintain a moving posture during any 24-hour period. As a unit moves, the length of time it has been moving is tracked on a running basis. If the unit reaches its limit, it stops and rests until it can resume moving. Once the unit's number of hours moving in the last 24 hours is reduced below the limit, the unit is permitted to start moving again, and does so. This limit is applied to units in all the moving postures: Moving, Attack, Delay, and Withdraw.

3.2.2 Ground Unit Attack Operations

Only Ground Combat units can perform the Attack mission. Usually, an Attack directive is part of a larger plan, which might consist of several units attacking, other units reinforcing them by fire, and other units following in reserve, or for exploitation.

An Attack directive may specify a route to follow, a Foreign unit to attack, or both. If both are specified, the unit adds the location of the Enemy unit to the end of the attack route, as that location is known at the time of execution of the directive. Whether a Foreign unit is specified or not, once the attacking unit reaches its destination, it will remain in the Attack posture until the destination hex contains no Enemy units. Once the hex is clear of Enemy units, the attacking unit reverts to a Defend posture.

As an option, the player may specify that the attacking unit is to perform a Move to Contact. The unit is permitted to do so provided it is not already in combat. When a unit uses the Move to Contact logic it assumes the ATTACK posture, and moves along the attack route, but does not pay the full movement speed penalty for being in the ATTACK posture. Instead, it moves at a speed that is the average (arithmetic mean) of the Attack speed and the Administrative Move speed.

3.2.3 Combat Systems

Any number of combat systems may be represented in the scenario database. Each system is described in terms of various characteristics including maximum effective range, lethality, recoverability and repairability, and type of fuel and ammunition required. Combat systems are also characterized as direct or indirect fire systems, with the appropriate differences in attrition calculations.

Indirect fire systems may also be employed explicitly. All munitions are delivered to a set of terrain coordinates. All units, supply convoys, air missions on strip alert, and targets in the vicinity of the fire are subject to attrition, regardless of who fired. Nuclear and chemical munitions may be fired. Based on the data incorporated in the scenario database, casualties occur both instantaneously and over the period of time a unit remains in a contaminated area. Any ground combat unit may be directed to support any other non-naval unit with indirect fire resources. Any ground unit may be ordered to lay or clear mines and to repair targets.

3.2.4 Artillery Operations

Artillery weapons that are specified as Combat Systems in JTLS can be used in three distinct ways:

1. Lanchestrian combat. Enemy units are in proximity, and fighting. All of the available Combat Systems are applied to the process of causing Enemy casualties.
2. Direct Support. One or more Ground Combat or Naval units have been directed to provide direct support fire for another unit.

3. Explicit Fire.

   a) Fire missions may be directed against specific latitude/longitude or military grid locations; against a list of Enemy, Neutral, or Friendly targets; or against a list of detected Foreign units.

   b) The Artillery weapons may be part of an HRU and used for its combat operations.

Any kind of ammunition can be explicitly represented in JTLS as a targetable weapon. The projectile types that artillery units can fire are a subset of all Targetable Weapons included in the database. Other targetable weapons include: SSMs, bombs, torpedoes, Surface-to-Air and Air-to-Air missiles, and munitions for explicit use by HRUs. Each projectile has its own set of targetable weapon characteristics, including its time to fire, supply category, type of guidance, lethality index (area or point damage), and its effects type. Artillery can fire targetable weapons that cause either area or point damage.

3.2.5 SSM Operations

Unlike Artillery Combat Systems, Surface-to-Surface Missile launchers are used only for explicit fire missions. Surface-to-Surface missiles, both land-based and sea-based, are fired from SSM targets owned by the firing unit. Each SSM target type can fire one designated type of missile (targetable weapon) having its own set of parameters (targetable weapon characteristics). A unit can fire more than one type of missile, provided it owns more than one type of SSM target.

Missiles are fired in two ways. First, units that own Surface-to-Surface Missiles may be directed to fire those missiles at a specified location, target, Foreign unit (naval or ground), or along a range and bearing.

Like all targets, SSM targets have one of three mobility classes: Stationary, Deployed While Moving, and Mobile. SSMs that are Stationary or Deploy While Moving (e.g., on ships) are assumed to be in a state of advanced readiness for firing. Mobile missiles may be in a state of “Prepared to Fire,” “Preparing to Fire,” or “Unprepared.” SSM launchers that are Unprepared are more difficult to detect than otherwise, and the initialization of preparations to fire both increases the detectability of the SSM launcher and may trigger a detection of the activity by surveillance assets covering the area. The increase in SSM readiness is initiated only in response to a player order to fire or to prepare to fire.

One of the targetable weapon characteristics specifies whether the missile is restricted to flying over water or land, or whether it can fly over land and water. In the case of the range and bearing launch of a missile to a water hex, the missile flies to the specified range and bearing location and turns on its sensors. If it does not locate a suitable target or unit, it continues on the assigned bearing until it encounters something to attack (Enemy or Friendly) or finds a land hex. If it encounters a land hex, the missile flight is ended, and no damage results.

The second method by which missiles are launched is by automatic engagement between naval units. If the naval unit has a Ground/Surface ROE that permits it to engage ships of other sides, its owned SSM targets may be used to conduct such engagements. If a Foreign unit is subject to engagement under the ROE, the unit will engage using available SSM, as soon as the Foreign vessel is detected within range.

Unlike artillery rounds and air-to-air weapons, SSM can be shot down before they impact. Depending on the data, they may be engaged during:

1. the terminal phase of flight, in the impact area;
2. both terminal and mid-course phase; or
3. not at all

Engagement depends on the presence of capable Air Defense systems. During the mid-course phase, ADA systems require permissive ROE to fire. In the terminal phase, any ROE except No Fire permits engagement. Engagement can take place in both the mid-course phase and the terminal phase, regardless of the source of the launch.

3.2.6 Targetable Weapon Effects

All targetable weapons in JTLS cause either area or point damage. Area weapons, both precision-guided and non-precision guided, cause damage to one or more objects in the impact area, and may result in fratricide. Non-precision point weapons hit the targeted object, if there is one in the covered area; otherwise, an object in the covered area is randomly selected. Precision point weapons hit the targeted object, if it is in the covered area; otherwise, an object in the covered area is selected, using an algorithmic “best” pK.

A point damage weapon can cause damage to one “object” in the affected area. The definition of an “object” depends on what is being damaged. For a unit, one “object” is a packet of Combat Systems or supplies, whose size is specified in the database. For a Supply Run, it is one truck, barge or railcar. For an air mission on the ground, it is one aircraft. For SAM.AAA, SSM, Aircraft Shelters, and MHE targets, it is one component of the target (one launcher, a single shelter, or a single piece of MHE).

There are four types of targetable weapon effects: conventional, chemical, nuclear, and mines. Conventional munitions, including both High Explosive (HE) and Improved Conventional Munitions (ICM-bomblet type), cause conventional effects based on weapon type, target type, lethality data and algorithms that are described in detail in the JTLS Analyst Guide. Chemical and Nuclear munitions both cause immediate personnel casualties and also contaminate the area for specified periods of time. Mine munitions either create or add to minefields.

Targetable weapons also can be designated as Leaflet rounds by being issued from the LEAFLET supply category. These rounds disperse Psychological Operations leaflets in the vicinity of the impact point and may reduce unit effectiveness in the area.

3.2.7 Attaching and Detaching Units

Players may direct the attachment of one unit to another, and the detachment of one unit from another. This does not apply to Naval units. The attachment and detachment logic is also used for unit arrivals through ports, airlift and airdrop of units, and amphibious operations, including both opposed and unopposed pickups and landings.

Attachment has some restrictions. The two units to be attached must be on the same side, in the same faction, be of the same type (e.g., support units), and have the same type of aircraft if they are squadrons. The primary uses of the Attachment capability are to rejoin two units that were earlier separated, to provide a reconstitution opportunity, using two units, or to permit task force tailoring.

3.2.8 Mining and Minefield Clearing

Minefields are represented as target entities in JTLS. They are displayed on graphics if they have any mines in them, i.e., they have not been cleared. They are also displayed on the IMT. There can be many types of minefields in JTLS. One of their distinguishing characteristics is whether the emplacing side retains knowledge of the 'paths' through the minefield. This is a data input. For such types as artillery emplaced scatterable mines, the side would probably not know how to safely get through the resulting minefield.

If a side has emplaced a minefield and retains knowledge of the “safe paths” then the minefield has no effect on objects belonging to that side, be they land units or ships.

If, on the other hand, the minefield is of a type where the emplacing side does not retain knowledge, then it makes no difference at all which side laid the minefield. it will slow up and cause casualties to all sides.

Players can direct ground units, naval ships, or formations to lay or clear minefields, provided the units have that capability. The time expended depends upon the capabilities of the unit and the size and number of the minefields. For mine laying, the Player specifies the number of mines and type to emplace. Each mine requires that the emplacing unit have the required amount of the appropriate category of supply. A unit that does not have enough of the mine supplies will lay all that it has. The effects of minefields are specified in terms of the number of “standard minefields” encountered. The number of mines in a standard minefield is an input data item which may be different for different minefield types.

3.2.9 Missions and Postures

A unit’s posture is displayed on graphics and IMT, and included in some reports to Players. The unit mission is the last thing that the unit was directed to do and is displayed on the IMT. Units change posture either in response to Player directives, because they have completed a task, because they cannot continue a task for some reason, or because they have been attrited until they are too weak to maintain their current posture. Units enter the game in a DEFEND posture, and revert to a

DEFEND posture upon completion of an attack or an administrative move. Generally, a unit never increases its posture, unless ordered to do so. The decreasing order of postures is ATTACK, DEFEND, DELAY, WITHDRAW, INCAPABLE, WIPED OUT. MOVING and AIR OPS are the same level as DEFEND. A unit that is forced to a WIPED OUT posture is removed from the game.

3.2.10 Air Defense

Most surface-based, air defense functions are automated since there usually is not enough time for the Player to respond to contingencies. The Player has three principal areas of responsibility for surface-based air defense:

1. ROE. Air Defense assets need ROE permission to engage Enemy objects. Each SAM/AAA target entity is either owned by or associated with a unit. The target gets its Force Side and its ROE from the unit.
2. Radar: Each ADA site consists of a single target entity that represents one or more ADA assets. The number of assets is specified by the TG NUMBER of the entity. Each asset consists of a sensor, and a number of firing elements. The sensor is considered a Fire Control Sensor, and provides radar tracking for its own asset only. The assets and indeed the site are dependent on other sensors for early warning and acquisition. This process is discussed in the paragraph that covers the Integrated Air Defense System (IADS). the Player must ensure that the ADA site remains connected to the IADS network to provide the required early warning and acquisition, or the ability of the site to engage enemy aircraft and missiles may be degraded or even reduced to zero.
3. Resupply. When each SAM or AAA target first enters the game, it is provided with a full load of ammunition or missiles. As those assets are fired, they must be replaced if the ADA site is to remain effective. The ammunition is replenished from the target's associated unit, provided that unit is within a database specified distance of the site.

3.2.11 Sensors and Jammers

Any unit can own one or more sensor or emitter targets. Three types of sensor are modeled in JTLS: air search, surface search and sonar. Air search sensors detect aircraft and missiles. Surface search radars detect surface ships. Sonars detect submarines and naval surface units. Three types of emitter are modeled: communications jammers, radar jammers, and broadcast emitters.

Players can turn on or off the sensors and emitters that a unit owns. They can specify that the emitters be left on until turned off by another directive, or can direct that they be turned on for a specified period of time. Each sensor or emitter target has a target subcategory that specifies the emitter type it represents. Each sensor type has an attribute that specifies whether it is subject to interference from jamming. All ship-owned emitting jammers and jammable sensors are subject to counter-detection by Foreign Sides.

Radar or communications jamming can also originate from Electronic Combat Air Missions (EC). For EC missions, the type of jamming is determined by the jammers included in the JAMMER LOAD for the type of aircraft flying that mission.

Radar jammers interfere with the capability of Enemy air search sensors to detect objects. The algorithm is based on a comparison of jammer power at the sensor source to the sensor's return signal power measured at the location of the object being detected. Communications jammers affect the transmission and receipt of messages in a similar manner, by increasing the amount of time it takes a unit to receive a directive or send a message to a Player. The Analyst Guide provides a detailed discussion of the algorithms for both types of jammers.

Broadcast emitters permit Players to perform Broadcast Psychological Operations directed at specific Factions on other sides. The results of the broadcast are felt by all units in the covered area, but most strongly by units of the targeted Faction. The effect in the game is a reduction in unit effectiveness, resulting in a decreased capability to fight and longer times to perform some actions.

3.2.12 Integrated Air Defense System (IADS) Networks.

IADS networks are explicitly represented in JTLS, and are subject to attack and disruption by land, air, or naval forces. An IADS network consists of ADA Sites, Sensors, and Comm Sites, with specified links between the members.

The links between the members are explicitly contained in the database. Comm sites may be linked to other Comm Sites, to Sensors, and to ADA sites. Sensors may be linked to Comm Sites and ADASites. ADA Sites can receive links from Sensors and Comm Sites.

The information flow is from Sensor to Comm Site (to Comm Site, etc.) to ADA Site. ADA sites only receive information. Sensors only send information, Comm Sites both receive and send information.

An ADA Asset whose site is on an IADS network, and has a functioning Fire Control sensor, has its full engagement and kill capabilities. If the Fire Control sensor is damaged, the site can still engage if it is connected to an IADS network. If the site is not connected to an IADS network, its probability of detecting and engaging foreign aircraft may be reduced (depending as always, on the data.) Finally, if the ADA Site is not connected to an IADS network, and the Fire Control Sensor is non-operational, that asset simply cannot engage. In order for an IADS network connection to assist the Asset in engaging, some sensor on the network must be tracking the Air mission in question.

3.2.13 High Resolution Units.

Two unit levels of resolution are represented in JTLS. Large, main force units such as brigades and divisions are represented at a high level of aggregation, and are called Aggregate Resolution Units (ARU). These units have been represented in JTLS since the first release. In this

release, a new type unit, the High Resolution unit (HRU) is introduced. This type unit is intended to represent very small units, such a SOF teams, small Civil Affairs units, Medical Assistance teams, Traffic Control points, and Non-Governmental organizations.

The structure of these HRU is based on a set of High resolution Prototypes, which describe the combat systems, supplies and target entities the HRU is issued when created. The HRU can be created as a result of database entries, arriving when their parent unit arrives, or as a result of Player action, being detached from a Parent unit that has the requisite combat systems and supplies to outfit the HRU.

HRU can perform the following missions, provided the required capability is indicated on their HUP.

1. Traffic Control;
2. Civil Affairs;
3. Coalition Support, providing translation services, and a capability to call in Close Air Support to allied units that may not have that capability.
4. Operate ADA targets;
5. Perform Intelligence Patrol Missions, breaking radio silence to report high interest objects or activities.
6. Perform Combat Patrols, engaging High interest objects, using their Combat Systems.
7. Establish and execute ambushes. The subject of an ambush may be a specific Unit or target, or may be any unit or target that fits a set of descriptions provided by the Player.
8. Execute a Direct Action mission, called a Raid. The subject of the Raid is always a specific unit or target.
9. Represent downed Aircrew, who have survived the destruction of their aircraft.
10. Own, (but not operate) SSM targets. In future releases, the HRU will be able to fire the SSM.

HRU can move across the land, using their own resources, or can be moved using air resources. The extraction of downed aircrew HRU can be played explicitly. HRUs have the capability to operate covertly, and must do so to execute an ambush. For all other combat operations, a Covert status is optional.

All attrition involving HRU is represented using the explicit expenditure of weapons logic in JTLS. New data parameters specify the type of Targetable Weapons used by each Combat System during High Resolution Combat. HRU can attrite and be attrited by other HRU, and main force units (ARU). HRU can also attack and damage targets. If the target is owned, after the initial engagement, the Targets owning unit is permitted to return fire at the HRU.

HRU are subject to the full effects of Air, Artillery and Missile fire, but are explicitly excluded from the casualties caused by minefields. They are not permitted to clear minefields at present.

JTLS includes a limited initial representation of Civil Affairs. When a Civil Affairs HRU is stationed in a location, it provides two benefits to its side. First, any stationary Civilian units that are from a Friendly or Neutral side do not contribute to the congestion penalty assessed against units and convoys moving in or through the hex. Second, when the unit performs a Tactical Intelligence update for its side, any of its HRUs that are performing a Civil Affairs mission can acquire information about any unit or target within intelligence range of any Friendly, Neutral, or Suspect Foreign unit in the same hex as the HRU. This can significantly enhance the intelligence-gathering capability of the Civil Affairs unit's side.

3.2.14 Psychological Operations

Psychological Operations (PSYOP) are modeled in JTLS in two ways: leaflet delivery and PSYOP broadcasts.

PSYOP leaflets can be delivered by artillery fire, SSM, Air Attack, or Air Drop to a unit. The leaflets are delivered to the targeted unit first, and then to other units in the area. Leaflets are fully effective against units that belong to the same Faction as the targeted unit, one half as effective against other units on the same side, and have no effect on units on other sides. Units on other sides do pick up leaflets. The effect of leaflets is to reduce the unit effectiveness. The amount of the reduction depends on the number of leaflets delivered to the unit.

PSYOP broadcasts can originate from a broadcast emitter owned by a unit, or from an EC mission that includes a broadcast emitter in its mission load. In either case, a targeted faction must be specified. The amount of effect from broadcast PSYOP depends on the power and duration of the broadcast. The effect of broadcast PSYOP is to reduce unit effectiveness.

Reducing unit effectiveness reduces the unit's ability to fight in land combat and to recover damaged systems and wounded personnel, and increases the amount of time it takes the unit to perform many tasks. Units whose effectiveness has been reduced by PSYOP recover as time passes.

3.3 LOGISTICS FUNCTIONS

JTLS provides Logistics Players significant and vital capabilities to augment the automatic requisitioning/delivery process. Logistics Players must interact with the model by monitoring the IMT, requesting reports, interpreting advisory messages, scheduling resupply airlifts, sending resupply to units in trouble or lacking supporting units, changing stockage objectives and reorder levels, assigning new support units, or directing mandatory transfers of supplies. The commander's concept of the operation must consider a variety of combat support and combat service support activities. The following logistics capabilities exist in JTLS:

1. Movement of supplies between units by truck, barge, or rail
2. Use of trucks from one unit to pick up supplies from one or more other units, and deliver them to the other units or locations.
3. Mandatory transfer of supplies from one unit to another
4. Automatic or Player-directed resupply of units
5. Creation of logistics loads for use in future orders
6. Creation of supply caches for future use
7. Operation of pipelines, including drawing supplies from the pipeline and replenishing supplies
8. Capture of Enemy supplies and recovery of own supplies
9. Modification of stockage objectives and/or reorder thresholds of one or more supply categories for either a single unit, a group of units, or all units
10. Change of the depot from which a unit orders its supplies or from which a pipeline is replenished
11. Airlift Operations (through the air module). An aircraft squadron or helicopter company is capable of lifting either a unit or supply load from a loading location to an offloading location.
12. Airdrop Operations (through the air module). An aircraft squadron or helicopter company is capable of airdropping a unit or supply load at a specified primary location or alternate location.
13. Sealift Operations (through the naval module). A naval unit or formation is capable of sealifting either a unit or a supply load from a loading location to an offloading location.
14. Evacuation of casualties whose expected recovery time is longer than a Faction-specific maximum time. Casualties are evacuated by convoys that deliver supplies to the unit, and are evacuated to the unit’s support unit. Players also can cause evacuation of casualties using an Airlift or Sealift order, in addition to the Directed Resupply and Automatic Push. Evacuation to medical units requires player intervention.
15. Evacuation of Remains (KIA). A fraction of those personnel who are killed are recovered by their unit. These KIA are retained by the unit until they can be evacuated. Evacuation is by the same methods as for casualties. Casualties have priority on backhaul convoys.

3.3.1 Supplies and Supply Categories

The use of the unlimited supply capability permits assessment of both the logistics and combat results in an environment that is totally unconstrained by availability of supplies.

At the other extreme, high-resolution micro-management of the logistics situation is permitted by the very specific Directed Resupply, Airlift, Airdrop, Sealift, Reorder Level, and Stockage Objective directives. Between these two extreme conditions, modeling normal constrained availability, automatic requisitioning, and automatic (Player-initiated) Push shipments provides a medium-level management-by-exception capability.

An essentially unlimited number of different supply categories can be represented. Categories of supply need not correspond to the standard military classes of supply. One unclassified database for JTLS included the following categories:

1. Personnel
2. Aviation fuel
3. Ground fuel
4. Major end items
5. General ammunition
6. Artillery ammunition
7. Mines
8. Engineer supplies

Database input variables determine the normal periodic consumption rate for each category of supply by unit. In addition to this “normal” consumption, units that are in combat (or moving) will consume supplies at higher rates. Explicit expenditure of supplies occurs in JTLS because of events such as: ground or naval indirect fire missions, destroyed convoys, depots that have been attacked, air movement (airlift and airdrop), and air engagements.

Reports to players that concern amounts of supply can be displayed using several different units of measure, at the Player’s option. The database is built using a set of consistent units of measure; and, internal to the CEP, data are held in those units. When messages are presented to Players or data concerning supplies are displayed on the IMT, the Player may change the Unit of Measure for each category of supply. For example, in one database, DRY supplies may be displayed in long tons, short tons, metric tons, or kilograms, while WET supplies can be displayed in gallons or liters. The Units of Measure and their conversion factors are part of the database.

The logistics module includes a maintenance function that simulates the initial fail on issue rate, repair of systems damaged in combat, and their eventual return to operational status. Each Combat System has several attributes in the database; one of these specifies a percentage of casualties that can be recovered from combat, and another specifies a percentage of those that will eventually return to their combat unit. This method is used to represent recovery and repair times of various Combat Systems.

Explicit supply categories may be specified for Casualties and Remains. If no such categories are specified, the evacuation of casualties is not represented, nor is recovery and evacuation of remains. The representation of the two are independent. A database may have either, neither, or both.

3.3.2 Support Unit Operations

As part of the data that describes a unit, a general support unit and separate support units for each category of supply can be specified, as well as a time between supply adjustments. Each time a unit performs a supply adjustment, it computes the amount of each class of supply it has used, whether it owes supplies to any other unit, and whether it should requisition more supplies. If it needs to requisition more supplies, it requisitions them from the unit specified to provide that category. If none is specified, the requisition is sent to the general support unit.

When a supporting unit receives a requisition, it ships what it can, and places the rest on backorder. As more supplies or more transportation assets become available, the supporting unit looks at each backorder, and fills them in priority order. The priority is: Directed Resupply, Automatic Push, Combat, and Normal. Directed resupply and Automatic Push result from Player directives. A combat backorder is one from a unit that is in combat, or from a unit supporting a unit in combat.

3.3.3 Directed Resupply, Convoys

A Player can direct that a support unit, airbase, or FARP (Forward Arming and Refueling Point) send a one-time shipment of supplies to another unit. This creates a Directed Resupply requirement at the shipping unit. The shipping unit will either ship the supplies by convoy or backorder them. A Directed Resupply can be used to build up stocks prior to an operation, or to temporarily solve a supply shortage problem.

With this delivery, a new capability for convoys was added. The truck assets from one unit can be dispatched to another unit, or units, to pick up supplies, for delivery to other units in the scenario. The convoys attempt to fulfill the requirement, but a 'Fill or Kill' philosophy is followed. If the required supplies are not available at a pickup point, the convoy continues on its route delivering what it can. Upon completion of the route, the convoy returns to the unit that owns the trucks, for further tasking.

3.3.4 Automatic Push

A Player can direct that a support unit, airbase, or FARP send a periodic shipment of supplies to another unit. This creates an Automatic Push requirement at the shipping unit. An Automatic Push requirement is the second highest priority requirement. The shipping unit will either ship the supplies or backorder them. The period may be any length of time. The Automatic Push order was designed to be used by units without a supporting unit from which to requisition. It has also proved useful for establishing throughput shipments for units attacking or supporting attacks, to keep them supplied with fuel and ammunition.

3.3.5 Pipeline Operations

A pipeline consists of a source node, one or more pipelines arcs, and one or more other nodes. Units in the game interact with Supply Storage Area targets associated with the pipeline. When a unit goes through the Adjust Supplies process, it accesses available supplies from Supply Storage Area targets in the area before it requisitions supplies. When it tries to fill a requisition, it takes supplies first from local supply storage area targets. These include pipeline associated targets. The Supply Storage Area targets have a limited amount of supplies available. When a unit takes supplies from a pipeline target, it creates a requirement that the target be refilled. The supplies are replenished by the unit that is designated to operate the pipeline.

In order for the Supply Storage targets at a Pipeline node to be refilled, there must be a Pumping Station, associated with the pipeline, located at the node.

3.3.6 Mandatory Transfer

While only support units, airbases, and FARPS can originate Directed Resupply and Automatic Push actions, any unit can originate a Mandatory Transfer. There are several differences between a Mandatory Transfer and other supply actions. The most significant is that in all supply actions except a Mandatory Transfer, the shipping unit retains a portion of its basic load, and prevents any of its issued Combat Systems from being shipped. For a Mandatory Transfer, nothing is held back. The requirement is fulfilled to the maximum extent of the shipping unit's ability.

3.4 AIR COMBAT OPERATIONS

The air portion of model play can be achieved using either the automatic Air Tasking Order (ATO) generator, by entering all the directives manually, or by a combination of the two methods. An ATO can be created for the Players to plan and schedule missions well in advance of their desired launch and alert times. The Air Tasking Order Generator (ATOG) permits the building of mission “packages” that are composed of different types of aircraft. It also allows Players to create individual, single-aircraft missions. The following types of missions can be tasked:

1. Airborne Warning and Control System (AWACS)
2. Aerial Refueling
3. Combat Air Patrol/Defensive Counter Air, or in orbit, at a location or referenced to the location of a unit.
4. Offensive Air Support--Close Air Support, or in orbit, at a location, or referenced to a unit.
5. Escort
6. Reconnaissance and Armed Reconnaissance
7. Electronic Combat
8. Air Interdiction and Offensive Counter Air
9. Air Defense Suppression (Wild Weasel)
10. Airlift
11. Airdrop

12. Area Patrol Missions (ASW [Anti-Submarine Warfare] surveillance)
13. Transfer of aircraft to another unit
14. Insert/extract of HRU
15. Transport of Supplies, following a sequence of pickup, dropoff and route transit points.

The Air Tasking Order Translator (ATOT) software tool is designed to read a data file containing an actual USMTF Air Tasking Order (ATO, generally produced by the USAF's CTAPS ATO generator program). It then translates the ATO into a set of Air Mission orders for use in a JTLS scenario.

3.4.1 General Functions

Modeling the air assets includes both the aircraft and the weapons that they use. Aircraft are given mission orders that describe details such as: the routes to fly, rendezvous or orbit points, the type of mission to perform, number of aircraft, targets to strike, and arrival time. For example, aircraft that are directed to perform combat air patrol missions are assigned an orbit location and will remain at that location until they are directed to a new orbit location or they must depart due to a lack of fuel or weapons. Airlift and airdrop missions are checked within the model to determine the aircraft capacity available for flying. Then, the air module logic will schedule the appropriate number of sorties.

All missions that can be sent to orbit locations (CAP [Combat Air Patrol], Orbiting OAS [Offensive Air Support], AWACS, Air Refuel, Electronic Combat, Orbiting Recce, and Mining) can alternatively be defined as strip alert missions. These are subsequently launched either automatically (under certain circumstances) by the model or by Player order.

Standard mission loads are configured for each aircraft type as part of the scenario database. When an air mission is flown, the model selects the load based on database input priority, mission type, environmental conditions and ordnance stocks, and then flies the mission. Damage is assessed based on the weapons effects entered in the database for that aircraft and the weapons in the load (either area effects or a specific probability of kill may be specified). Air-to-Air Rules of Engagement are specifically represented at both the squadron and individual mission levels. The Player can override the automatic weapons load by specifying a specific weapons mix on the mission order.

As missions are flown, weapons and fuel are deducted from available stocks. Returning flights return unexpended weapons and fuel to inventory. When the weapons specified in the primary weapon load are not available, a mission will fly with its secondary or tertiary load alternative, if one has been specified in the database.

Returning aircraft automatically enter maintenance and are unavailable for re-tasking until maintenance is complete. Player directed sorties for which aircraft are unavailable will be delayed until aircraft become available or the maximum launch delay time has expired.

Unless directed otherwise, aircraft will fly at their most efficient altitude for fuel consumption purposes. When calculating air routes, missions will optimize around known Enemy SAM/AAA sites.

Aircraft require a specific runway length (separate values for takeoff and for landing) for operation according to the type of the aircraft. Returning aircraft, confronted with a damaged runway, will divert to their alternate runway. Future launches are delayed until repairs have restored the runway to a usable length. Lack of required supplies or available repair crews will further delay restoration of flight operations.

Air defense is represented by the activities of SAM/AAA sites, which are capable of engaging Enemy aircraft, and may be capable of engaging Enemy missiles. Engagement ranges and probabilities of kill of SAM/AAA sites are dependent on target altitude.

As noted elsewhere, the capabilities of Air Defense assets is significantly affected by the availability (or lack thereof) of an IADS network.

3.4.2 Offensive Air Operations

Offensive air missions include Wild Weasel, Air Ground Attack, Armed Reconnaissance, Patrol, and Orbiting Offensive Air Support missions.

The Wild Weasel mission is specifically tasked to suppress Enemy air defenses. The Air Ground Attack mission is best suited for attacking things that are fixed, or where there is a reasonable amount of time to plan. The Armed Reconnaissance is best used to look for and attack moving objects, such as convoys, and moving units, including naval units. The Patrol mission is used to locate Foreign submarines and surface ships, and if armed, will attack them, ROE permitting. The Orbiting Offensive Air Support (OAS) mission is suitable to respond to calls for immediate air support. The OAS is also useful for attacking newly pinpointed units beyond the FLOT (Forward Line of Troops) in order to slow them down; for attacking interdiction points to block an Enemy maneuver; or even (if properly loaded) for an immediate suppression of Enemy air defense, (perhaps to assist a returning air mission package or support a CAS [Close Air Support] strike).

An OAS mission can be a strip alert mission (or QRA.OAS), either at home base or at some forward location. QRA.OAS missions can be used either to fulfill requests for Close Air Support (CAS) or to launch as Air Ground Attack missions.

3.4.3 Defensive and Alert Air Operations

Combat Air Patrol (CAP) missions, either orbiting or on strip alert (QRA.DCA), are available to defend a side's airspace against Enemy air missions. The Enemy missions must be detected and must come within the defensive mission’s protection radii. Finally, the defensive missions must have an ROE that permits them to engage after interception.

An airborne CAP mission takes off, flies to its orbit location, turns on its sensors, and waits to be committed. The Player specifies a protection radius in the directive, and also specifies whether the mission is eligible for automatic assignment by the model, or can be committed only by a Player's Manual Pairing action.

When the mission is committed by the model, it is never committed to intercept a mission that is farther from the CAP's orbit point than the protection radius, and the CAP mission will not go outside that radius, even in hot pursuit. However, it may shoot outside that radius if it has long-range weapons and appropriate ROE.

If a Player attempts to commit the CAP to intercept a mission outside its protection radius, the CAP will commit and head toward the intercept point. If it reaches the limit of its protection radius, it will break off the intercept and return to its orbit point.

The Alert CAP (or QRA.DCA) mission is a strip alert mission. When it begins operations, it loads the specified weapon load for Air-to-Air. If a Forward Operating Location (FOL) is specified, the mission takes off, flies to the FOL, refuels and rearms, and goes on ground alert, ready to launch. Until it finishes refueling and rearming it is not available for intercepts. If no FOL is specified, the mission goes on alert at home. Once on alert, the Alert CAP mission waits to be committed to intercept, or moved to orbital alert.

IFF is represented in JTLS, and may result in initial misidentification of air missions. CAP missions engage based on both the perceived side of the detected mission and their ROE for that side. A mission may be engaged and killed before it is correctly identified if it enters the detection capability of a CAP mission with long range weapons and is already within ROE range.

3.4.4 Support Missions

Support missions include AWACS, Reconnaissance (Recce), Orbiting Recce, Air Refueling (AIREF), Electronic Combat (EC), and Escort missions. They provide functions that help other air missions or the Player perform their functions.

An AWACS carries a sensor load that allows it to detect, track, and identify other missions. Its load may include a surface search sensor giving it the ability to detect and report Foreign naval units.

The AIREF mission is an independent orbiting or strip alert mission. Once the tanker reaches the orbit area, it is designated as available to give fuel. The model handles the entire refueling procedure automatically. The Player can specify that an AIREF mission be permitted to give fuel to missions belonging to another Friendly Force Side. In addition, the Player may reserve fuel on the AIREF mission for specific missions, by specifying a list of missions for which fuel is reserved and the amount reserved for each mission. This list is specified as part of the AIREF directive.

The Recce mission provides two important functions. First it updates the side's knowledge of the battlefield. Second, as a support mission in an Air Mission Package, the Recce provides detailed battle damage information when the package returns. An Orbiting Recce mission orbits a a specified location for a directed time collecting intelligence for its side.

Like the AIREF mission, the EC mission is an independent mission. EC missions can carry radar jammers, communications jammers, broadcast emitters, or any combination of the three.

The Escort mission exists only to support Air Mission Packages. Its job is to protect the Package from Enemy air missions. Like all other support missions, it meets the rest of the package at the time release point. Escort missions only engage air missions that are attempting to engage the Package they are protecting. Escort missions are automatically provided information concerning intercepting aircraft. They are allowed to fire as soon as the escorted package is within ROE firing range and weapons range of the intercepting missions.

3.4.5 Mining Missions

If the aircraft are capable, air missions can both lay and clear mines. Separate capabilities are specified for laying and clearing mines and for land and sea minefields.

3.4.6 Air Mission Packages

An Air Mission Package is a group of Air missions with a common purpose, just as an air mission is a group of aircraft with a common purpose. An Air Mission Package's common purpose is to permit a group of Air Ground Attack missions to transit the FLOT or some other high intensity environment, and then disperse to attack multiple, geographically separated targets. In addition to the Air Ground Attack missions, the Package may include SEAD, Escort and PostStrike recce missions. The Package meets at a common rendezvous point, called the Time Release Point. The package leaves the time release point at the release time, unless more assets are still coming to join the package. In that case it waits. If assets continue to be delayed, the package may wait until just before a further wait would make them miss their TOT by more than the maximum launch delay for the Air Ground Attack mission type. At that point, unless the package is short of SEAD or Escort missions, it will commit. If it is short of SEAD aircraft or escort air craft, it will abort.

Missions from any friendly side can join the mission. players can even, after significant coordination, create three or four sided Packages.

3.4.7 Airlift, Airdrop, Air Transport, and Insert/Extract

JTLS provides for both units and loads of supplies to be moved by airlift or airdrop. A Player can airlift a Friendly or Neutral unit, and specify any unit to receive the supplies for an airlift or airdrop. When supplies are airlifted, they are drawn from units (first priority) or supply dumps in the vicinity of the pickup point.

For both airlift and airdrop, multiple missions may be used, coming not only from different squadrons, but from squadrons with different types of aircraft. For airdrop, fixed-wing aircraft require a runway at only the pickup location. Helicopters do not require a runway at either the pickup or drop locations.

Leaflets can be airdropped to a unit. If the relationship between the dropping side and the receiving unit's side is Friendly, the drop is considered to be a resupply drop. Otherwise, it is considered a PSYOP drop, and the leaflets are distributed to the receiving unit and other units in the area, with PSYOP results.

The Air transport Mission is a (possibly) combined airlift/drop of supplies. The mission permits a Player to commit aircraft to go to a series of locations picking up and dropping off supplies. If the point is a dropoff, it may be either an airdrop point or a point at which to land and deliver supplies. Supply pickup requires landing. In addition to a location and a list of supplies, a unit may be specified. If specified, the unit is the intended source or receiver of the supplies. If no receiving unit is specified, the standard Airlift/ Drop delivery logic is followed. If no unit is specified at a pickup point, the mission attempts to find the supplies at local own side units and targets.

The Insert/Extract mission is an analog to the Air transport mission, except that the objects being transported are High Resolution Units. As with the Air Transport mission, a series of points is followed, which may be pickup points (landing required), drop off points, (air drop or land and offload,) or simply transit points.

3.4.8 Moving Squadrons and Aircraft

Fixed wing squadrons can be airlifted from one airbase to another, but cannot perform ground moves. Squadrons can airlift themselves. Rotary wing squadrons can perform ground moves, but it is generally more efficient and safer for them to be airlifted.

There are several ways to move aircraft from one squadron to another. In all cases, the two squadrons must have the exact same type aircraft, as JTLS does not permit composite squadrons.

The primary and most straightforward means of moving aircraft is the Transfer mission. The Transfer mission permits the Player to specify that a squadron is to transfer some number of aircraft to a location. Only the number of aircraft, new location and the desired time need be specified. The aircraft are transferred to that location, provided a suitable landing area is found. If an own side squadron with the same type aircraft is present, the aircraft are added to that squadron. Otherwise an independent squadron is created, and assumes ownership of the aircraft. This permits contingency stationing, such as for a NEO, or other possible but uncertain future operation. Another way is to specify the unit that is to receive the aircraft as the Return Squadron on any air mission. The aircraft fly a normal mission, but they return to the new squadron and become part of its complement of aircraft.

3.5 NAVAL COMBAT OPERATIONS

Naval units can perform the following operations, either independently or in a formation:

1. Ship-to-ship combat using naval gunfire or SSM
2. Shore bombardment using naval gunfire or SSM
3. Amphibious pickup transportation and assault
4. Area patrol and ASW
5. Naval air operations
6. Air defense, including terminal defense against missiles
7. Mine warfare
8. Shadowing of Foreign naval units

3.5.1 Surface Units

Naval surface units have the ability to maneuver and engage targets with naval gunfire and Surface-to-Surface Missiles. Aviation carrying assets of all types may be included in the scenario. Units have the ability to maneuver and conduct air operations simultaneously. JTLS models all types of naval combat. Attrition is based on weapon pK or area effects, as modified by environmental conditions. Ships may be joined in a formation and moved as a task organization.

Ships have ROE just as other units do, and use them in the same way, except for the Ground/ Surface ROE. Naval units whose surface ROE is set to “Weapons Free” will automatically engage known Enemy ships with missiles, if they can.

Various ship capabilities, including onboard aircraft, are degraded or rendered inoperable when subjected to Enemy attack. Ships will sink when they have sustained too many hull breaches. Repairs to damaged systems are made based on time factors set in the database.

Units and supplies may be sealifted with offload rates contingent upon the presence of a port facility and Materiel Handling Equipment.

3.5.2 Submarines

Submarines are modeled as unique types of naval units. They enter the game in a covert, undetected status. They cannot be seen by radar, but can be detected by shipboard sonar or ASW aircraft. Once detected, contact is eventually lost if not maintained by the detecting side. The submarines are usually equipped with sonar, SSMs and/or torpedoes. They can only be damaged by weapons specifically designated to be effective against submerged targets.

If submarines are required to operate in water shallower than a database specified depth for the submarine class, they lose their covert capability, and can be detected by any sensor that can detect a surface vessel.

Like surface units, they can be part of a formation or operate independently, and can be used to shadow Enemy surface units, lay mines, or patrol multisided polygonal areas.

3.5.3 Amphibious Operations

Ground units and assault helicopter squadrons can be embarked on naval units in formation at game start, or picked up from shore locations in preparation for amphibious assault. Amphibious assaults may be conducted, by moving assault forces ashore in groups via landing craft and helicopters. If such landings are opposed, attrition is modeled using distinctive Lanchestrian coefficients. Attrition of landing craft due to artillery and Ground-to-Air action, and the associated loss of combat systems are modeled.

3.6 COMMAND, CONTROL, COMMUNICATIONS, and INTELLIGENCE (C^3I)

The commander and staff must possess information about their Enemy in order to execute the military mission with adequate and timely tactical plans. One of the defining characteristics of a Force Side is that all the units share the same perception of the battlefield. When any collection resource obtains intelligence, the information is available to the entire Force Side. Different gathering methods have different delays and fusion times, but once the information is passed to the receiving unit, it is available to all members of the side.

When units or targets are first detected by a Force Side, their exact identification may not be known. In this case, the object is displayed as an Unidentified object, with a name starting with UI, followed by a six-digit sequence number and a unique letter. The true identification of the object becomes available after the fusion time has elapsed.

JTLS Players have the ability to share intelligence (on individual or multiple units and/or targets) with another side. The specified information is passed to the receiving side either as a one-time event or periodically.

JTLS can be operated with the graphics display or Information Management Tool showing game truth or a side's perception of truth. When running in the perceived mode, the commander must take action to determine the true location of Enemy units. All intelligence gathered data are available to be displayed on the IMT/Graphics display as soon as they have been fused and passed from the gathering agency to the responsible unit. The results are also included in the intelligence section of the Periodic Report.

3.6.1 Organic Ground and Air Intelligence

Each unit in JTLS can have a capability to note and report the presence and status of Foreign units and targets in its vicinity. The vicinity is defined by ground and air distance parameters unique to the unit's prototype. This capability models the unit's capability to patrol the immediate vicinity and report on what is there. The Player does not need to do anything to get the resulting intelligence.

3.6.2 HRU Intelligence Collection

A player may direct an HRU to perform a Patrol mission, with a sub-mission of Collect EEI. As part of the order, the Player specifies a single type or list of types of objects that are of high interest to the HRU and either a specific location or a route for the patrol to follow. The patrol moves to the location or the first route point and begins the intelligence gathering. If an object of high interest is encountered, the HRU breaks radio silence and reports the presence of the object, in a new "HRU Urgent Report". Objects that are detected but do not meet the High Interest criteria are retained and reported periodically. A message and graphics and IMT updates are all produced. In addition, any HRU performing a Collect EEI mission may detect and report either Missile launches or preparations of mobile TELs for such launches.

3.6.3 Explicit Air Intelligence

The Recce and Armed Recce missions collect information on all units, targets, convoys and air missions within sensor range of their designated flight paths. Attack and Offensive Air Support missions collect information only in the hex associated with their assigned target. Real time sensors report information gathered each time the mission moves into a new hex. Non-real time sensors hold on to the information until the mission lands at its home base. If the mission is killed prior to returning to base, the non-real time data are not reported.

3.6.4 Naval Intelligence

Surface naval units can be detected by land based surface sensors, shipboard surface sensors or surface sensors located on air missions including AWACS, Patrols, Reconnaissance, Armed Reconnaissance, and Air Ground Attack. Surface detections are accomplished as a stochastic process using a probability of detection. Subsurface naval units can be detected by the same sources, but the subsurface detection algorithm uses a stochastically generated time to detection.

Any actively emitting sensor on a naval unit is subject to passive detection by other naval units. The user receives bearing information and a rudimentary indication of the strength of the passive signal.

3.6.5 Non-theater Intelligence Collection Resources

Non-theater intelligence collection assets are represented in JTLS by Controller orders. These orders include:

1. Area Collection - All detected units and detected targets within the specified rectangular area are reported to the indicated side. Detection is stochastic and the Controller indicates the baseline probability of detection for units and a baseline probability of detection for targets.
2. Unit Collection - Information concerning the Controller-specified units is passed to the indicated side. The information concerning the specified units is always sent.

3. Target Collection - Information concerning the Controller-specified targets is passed to the indicated side. The information concerning the specified targets is always sent.
4. Electronic Intelligence (ELINT) - The Controller enters an order to indicate that a side has theater ELINT assets available. The entire theater is assumed covered until the Controller enters an order to remove the ELINT assets. When a side has ELINT assets available, players receive intelligence whenever an SSM or air defense site fires; and when a sensor or jammer site is either moved, activated or deactivated.

3.6.6 Reports to Players

The capability to obtain information, either through periodically disseminated reports or through Player queries, is essential to the successful planning and decision-making process. JTLS provides users with 30 queries and numerous reports that enable them to stay abreast of the situation. These are incorporated into four generic groups: Command (Ground and Naval), Air, Logistics, and Intelligence. These four groups are discussed in *The JTLS Controller's Guide* and *The JTLS Player's Guide*. The principal groups are:

1. Command (Ground and Naval):
   - Situation Report (SITREP): A Player may request a current Situation Report for any unit or group of units in that Player's reference database. The SITREP is available for HRU.
   - Periodic Report: The Periodic Report provides the commander with a summary of current own-side air, ground, and logistical operations; as well as intelligence held on other Foreign units and targets. The Periodic Report is made up of 15 separate messages, each reporting the current status of a subset of all the data concerning a side. Examples are the Own-Side Combat Systems Summary, Airbase and Squadron Summary, Other-Side Target Intelligence Summary, and BDA (Battle Damage Assessment) Reports. These reports are provided at a time interval specified in the database for the Force Side. A second parameter specifies the frequency of Summary Reports, which roll up two or more Periodic Reports. These reports have the same format as the Periodic Report, but cover multiple single periods.
2. Air:
   - Air Report: The Air Report provides a status summary of a squadron, its currently active missions, and aircraft due out of maintenance. Cumulative information is also provided, including runway length and repair time.
   - Air Mission Report: This report is available for a single squadron or all squadrons on the requesting Player's side (all squadrons for the Controller). It provides information concerning the status of all missions associated with the squadrons, including mission name, posture, time scheduled to launch or come out of maintenance, current number of aircraft, number of aircraft launched, mission type and location. In addition, the all-squadron report includes a list of unfulfilled CAS requests and a list of all airbases that are out of aviation fuel.

3. Logistics:
   - Logistics Report: This report is available upon request for a particular force or a specific unit. It contains general information, the status of Combat Systems (TOE, in maintenance, and operational), and the status of supplies (available as supplies, back order, or due in). The capacity of the unit to carry wet and dry supplies is included, as well as a listing of the backorders owed to other units or targets, including their origination times. For support units, truck status is provided; for squadrons, aircraft status is included. An abbreviated LOGREP is available for HRU.
   - Logistics Roll-up Report: This report is similar in format to the Logistics Report, but contains logistics data for a single unit, all its subordinates, and their subordinates, recursively. Details are omitted concerning individual units' trucks dispatched, aircraft flying and available, and the listing of backorders. This report is useful for obtaining a summary of the operational combat systems or the complete ammunition status of an entire division, for example.
   - Convoy Status Report: This report provides data about the status of all convoys that are outbound from a unit, inbound to a unit, or bound from one specified unit to another. The report includes the convoy home unit, next destination, location, ETA (Estimated Time of Arrival), status of transportation assets, and supplies carried.
4. Intelligence:
   - HRU Patrol Report: HRU with a collect EEI mission report their observations at a time interval set in the scenario database. This report contains information on units and targets seen. Depending on the length of time the Foreign units are observed, the HRU teams will report posture, status, location, and percent capability. The results are displayed on the Graphics and IMT screens. A message is generated.
   - Tactical Intelligence Report: The Tactical Intelligence Report is automatically provided by units on a periodic basis. Only units that have a specified capability to do so gather tactical intelligence. The results provide updated information on Foreign units and targets, with the amount of detail depending on the amount of time an entity has been observed. The intelligence is provided directly to the IMT and Graphics, and included in the Periodic Report. No printed message is generated.
   - ELINT Report: This report provides a listing of all detected and currently emitting jammer targets, and all detected and emitting sensor targets, provided the sensor is a jammable (emitting) sensor.
   - Launch Preparation and Launch Reports. Any surveillance asset may detect that a foreign unit has begun preparations to launch an SSM, or may detect the launch. These assets include units, airborne or surface sensor assets, and patrolling HRU. When either of these events is detected, the information is communicated as quickly as possible to the Players. A printable message is generated. Patrolling HRUs will break radio silence to report either preparation or launch.

4.0 SUMMARY

JTLS is a computer-based analytical model. With such a system, warfighting processes are simulated, and the users make decisions about the allocation of resources assigned to accomplish a mission. Ground combat results are determined using Lanchestrian equations. The attack of point targets, air or ground, is determined using a measure of lethality or probability of kill.

JTLS is designed so that it may be used, without modification, as:

1. a planning analysis tool,
2. support material for education,
3. exercise support for training, and
4. a primary means to investigate the results of combat.

In addition to including explicitly defined user requirements, the JTLS baseline design provides the following benefits:

1. The primary software language, SIMSCRIPT II.5, was designed for efficiently creating simulations.
2. User-machine interaction permits inputs and outputs to be available at independent terminals.
3. Screen menu capabilities and a message-handling system are provided to the user.
4. An expandable memory capability accommodates increased database requirements.
5. The design facilitates future product improvements.
6. Configuration management procedures provide for ongoing visibility and control of software and documentation.
7. A complete suite of documentation encompassing all areas of JTLS is provided.

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APPENDIX A. ABBREVIATIONS AND ACRONYMS

AAA	AntiAircraft Artillery
AADC	Area Air Defense Commander
AAL	Air-to-Air Lethality
A/C	Aircraft
ACP	Air Control Prototype
ADA	Air Defense Artillery
AEW	Airborne Early Warning
AFB	Air Force Base
AG	Air Ground (Air-to-Ground)
AI	Air Interdiction
AIM	Air Intercept Missile
AIREF	Air Refueling
AKL	Area Kill Lethality
AMMO	Ammunition
AO	Area of Operations
AOC	Air Operations Center
APC	Armored Personnel Carrier
ARECCE	Armed Reconnaissance
ARTE	Air Route
ARTY	Artillery
ASCII	American Standard Code for Information Interchange
ASW	Anti-Submarine Warfare
ATC	Aircraft Target Category
ATGM	Antitank Guided Missile
ATK	Attack
ATO	Air Tasking Order
ATOG	Air Tasking Order Generator
ATORET	Air Tasking Order Retrieve Program

ATOT	Air Tasking Order Translator
Attribute	A data item belonging to an entity, such as name, size, or number of subentities
AWACS	Airborne Warning and Control System
AZ	Altitude Zone
BADGE	Bilateral Air Defense Ground Environment (Used by JSDF)
BAI	Battlefield Air Interdiction
BDA	Battle Damage Assessment
BDE	Brigade
BN	Battalion
C3	Command, Control, and Communications
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, & Intelligence
CA	Civil Affairs
CAP	Combat Air Patrol
CAS	Close Air Support
CAT	Category
CCF	Central Control Facility
CCP	Command Control Prototype
CCU	Controller Change Unit
CEP	Combat Events Program The combat model in JTLS that simulates execution of ground, naval, air, logistics, and intelligence activities.
Checkpoint	A temporary halt in the game initiated either manually by the Controller or automatically by the CEP.
CMDR	Commander
CP	Combat Power
CS	Combat System
CSP	Combat System Prototype
CTAPS	Contingency Tactical Air Planning System
CTG	Commander Task Group
CTRL	Control, a keystroke as in “CTRL-C”
DCA	Defense Counter Air

DCL	Digital Command Language, the standard operating system user interface for DEC computer systems
DDS	Database Development System
DEC	Digital Equipment Corporation, the manufacturer of VAX/VMS computers
DEMSDB	Demonstration, Standard Database. A 5-sided database delivered with the current JTLS release.
DISA	Defense Information Systems Agency
DIV	Division
DMA	Defense Mapping Agency
DoD	Department of Defense
DOS	Days of Supply
DPICM	Dual Purpose Improved Conventional Munitions
DS	Direct Support
DSA	Directed Search Area
DTG	Date Time Group
acronymEC	Electronic Combat
ECM	Electronic Counter Measures
ECP	Engineering Change Proposal
ELINT	Electronic Intelligence
ETA	Estimated Time of Arrival
FARP	Forward Arming and Refueling Point
FLP	Fire Lethality Prototype
FOL	Forward Operating Location
FWL	Initials of Frederick W. Lanchester, generally credited with origination of the differential equation model of attrition, hence Lanchestrian attrition.
GAL	Gallon
GCCS	Global Command and Control System
GDS	GENIS Data Server
GENIS	Data Holder/Server Process
GIAC	Graphical Input Aggregate Control. The active interface between the player and the CEP.

GRTE	Ground Route
GS	General Support
GSR	General Support Reinforcing
GUI	Graphical User Interface
HARM	High speed Anti-Radiation Missile
HE	High Explosive
Hectare	10,000 square meters
HELO	Helicopter
Hex	Hexagon
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HQ	Headquarters
HRU	High Resolution Unit
HTML	HyperText Markup Language
HUP	High Resolution Unit Prototype
ICM	Improved Conventional Munitions
ICP	Interface Configuration Program. An interactive program that allows the user to define the specifications for each game process that can be started for a particular scenario
ICPLogin	Interface Login Program
ID	Identifier
IFF	Identification Friend or Foe
IIP	Intel/Information Prototype
IMT	Information Management Tool The JTLS program that provides real time tabular same information.
INFO	Information
Initialization	Phase of game during which data sets are read and the game is configured for Players.
INTEL	Intelligence
JMCIS	Joint Maritime Combat Information System
JMEM	Joint Munitions Effectiveness Manuals
JPL	Jet Propulsion Laboratory
JSDF	Japanese Self Defense Force
JTLS	Joint Theater Level Simulation

JWFC	Joint Warfighting Systems Agency
KIA	Killed in Action (aka “Remains”)
KM	Kilometer
KNOTS	Nautical miles per hour
LA	Lethal Area
LAN	Local Area Network
LAT	Latitude
LB	Login Build, a JTLS order type.
LDT	Lanchester Coefficient Development Tool This program assists in the development of Lanchester coefficients which are used to assess the results of force-on-force land combat in JTLS.
LOG	Logistics
LOGIN	Logistics Input, arrival in theatre or supplies
LOGREP	Logistics Report
LONG	Longitude
LOTS	Logistics Over The Shore
LR	Long Range
M&S	Modeling and Simulation
MAPP	Modern Aids to Planning Program
MB	Megabyte
MCP	Mobility Counter Mobility Prototype
MCR	Model Change Request. A form submitted by users and developers to report problems or desired enhancements to the JTLS model.
MG	Machine Gun
MHE	Material Handling Equipment
MIP	Model Interface Program, a Generic term for GIAC, MPP, IMT, etc....
MOGAS	Motor gasoline
MOPP	Mission-Oriented Protective Posture
MOSAIC	NCSA user interface software
MOTIF	An X Window System graphical interface
MP	Maneuver Prototype

MPP	Message Processor Program. This program displays exercise messages from the CEP to the Player.
MSC	Major Subordinate Command
MSG	Message
MTF	Message Text Formats
NCSA	National Center for Supercomputing Applications (University of Illinois)
NFS	Network File Server
NM	Nautical Mile
NTSC	Naval Telecommunications System Center
OAS	Offensive Air Support
OCA	Offensive Counter-Air
OJCS	Organization of the Joint Chiefs of Staff
ONC	Operational Navigation Chart
OPM	Online Players Manual
OPP	Order Preprocessing Program
ORACLE	A relational database management system
OTH	Over the Horizon
OTH Gold	OTH message Specification
OTH-T	Over the Horizon - Targeting
pD	Probability of Detection
pE	Probability of Engage
pH	Probability of Hit
pK	Probability of Kill
PKL	Point Kill Lethality
POL	Petroleum, Oil, and Lubricants
POSIX	An international standard based on System V and BSD.
PP	Postprocessor Program (a JTLS component)
PSYOPS	Psychological Operations
QRA	Quick Reaction Alert
QRA.DCA	Quick Reaction Alert, Defensive Counter Air

QRA.OAS	Quick Reaction Alert, Offensive Air Support
RAM	Random Access Memory
RDMS	Relational database management system
RECCE	Reconnaissance, normally refers to Air Missions
RECON	Reconnaissance, normally refers to Ground Missions
REGT	Regiment
RNS	Random Number Seed
ROE	Rules of Engagement
RPT	Report
RSP	Reformat Spreadsheet Program
SAL	Surface-to-Air Lethality
SAM	Surface-to-Air Missile
SAM/AAA	Surface-to-Air Missile/Anti-Air Artillery
SC	Supply Category
SCP	Simulation Control Plan
SDB	Standard Database scenario
SEAD	Suppression Enemy Air Defense
SIMSCRIPT	Computer programming language (product of CACI, Inc.)A multiple-pass compiler
SIP	Scenario Initialization Program
SITREP	Situation Report
SLP	Sustainment Log Prototype
SOF	Special Operations Forces
Solaris	A distributed computing environment from SunSoft.
SP	Survivability Prototype
SQL	Structured Query Language
SR	Short Range
SRP	Start/Restart Program (a JTLS component)
SRTE	Sea Route
SSM	Surface-to-Surface Missile
STR	Software Trouble Report

SUN	Sun Microsystems, Inc.
SUP	Ship Unit Prototype
SVP	Scenario Verification Program. Verifies consistency of data entered for a given scenario.
TADIL	Tactical Digital Interface Link
TCP/IP	Transmission Control Protocol/Internet Protocol. A set of computer networking standards that specify the protocol for two or more computers to use in communicating with each other. TCP/IP was developed by the Department of Defense to support its Defense Data Network.
TG	Prefix for Target Attributes
TGT	Target
TMU	Terrain Modification Utility. A utility program used to modify JTLS hex-based terrain files.
TOE	Table of Organization and Equipment
TOT	Time on Target
TOW	Tube launched Optically tracked Wire guided missile
TPFDD	Time-Phased Force and Deployment Data
TPS	Terrain Preparation System
TTG	Target Type Group
TTL	Target Types List
TUP	Tactical Unit Prototype
TW	Targetable Weapon
UBL	Unit Basic Load
UIM/X	GUI Builder Tool
UNIX	A computer operating language.
UNK	Unknown
UNT	Unit data file (<scenario_name.unt)
UOM	Unit of Measure
USA	United States Army
USAF	United States Air Force

USCG	United States Coast Guard
USMC	United States Marine Corps.
USMTF	U.S. Message Text Format
USN	United States Navy
UT	Prefix for Unit Attributes
UTM	Universal Transverse Mercator
VAX	A family of minicomputers developed by Digital Equipment Corporation. One of the host computers for JTLS.
VIFRED	Visual Forms Editor
VMS	Virtual Memory System
VTOL	Vertical Takeoff and Landing aircraft
WAN	Wide Area Network
WDRAW	Withdraw
WIA	Wounded in Action
WPC	Warrior Preparation Center
WPN	Weapon
WT	Weight
WW	Wild Weasel